Railway Mechanical Engineer

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Stimulating apprentices

A broad-minded superintendent of motive power, in combination with a wise shop superintendent, made it possible for the apprentices of a large railroad shop, within a night's journey of Chicago, to attend sessions of some of the railroad mechanical and electrical conventions in that city. Those who took advantage of this opportunity paid their own expenses, but were allowed the time lost from the shops. Each boy was asked to make a report to the shop superintendent in the form of a letter telling of the things which made a special impression upon him. The reports make interesting reading and indicate that this experience not only has a broadening effect upon the young men, but tends to stimulate their interest and study in the vocation for which they are preparing. A few other roads have followed a similar practice, but in a very limited way, in connection with the Mechanical Division conventions, and exhibits at Atlantic City. Are the railroads overlooking a real opportunity by not encouraging the younger men to attend and take advantage of meetings of this sort, as well as railroad club meetings? Some of the foremen's or supervisors' associations have made attempts to help the more ambitious of the younger men in various ways. Is it not well worth the effort?

How to save locomotive fuel

The urge for increased economy in the use of locomotive fuel becomes greater each year and many railroads have found that it pays to conduct practically a continuous campaign of education among engine crews, offering prizes of one sort or another to stimulate increased efforts in fuel economy. Since a large proportion of locomotive fuel is consumed on the road, it is evident that correct practices in firing are essential. In addition, the way in which the throttle lever and reverse quadrant is operated has a direct bearing on unit fuel consumption, hence the need for real harmony and co-operative effort between the engineman and the fireman. An admirable example of how an engineman and fireman can co-operate to save fuel and improve the performance of a steam locomotive is afforded by an engine crew on the Missouri-Kansas-Texas, which in the month of January, 1927, is reported to have handled a freight engine over 3,457 miles without once permitting the safety valve to pop. In this period, a total of 1,305 loads and 1,019 empties, or 90,557 tons, were handled, the total fuel consumption being 55,361 gallons of oil. The crew had 86 hours delay altogether and made 219 stops. This performance was particularly creditable because of the general prevalence of inclement weather, heavy winds and slippery rails and also because part of each run was made with a 3,000-ton train, followed by frequent stops during the balance of the runs for local work and switching. To provide maximum steam pressure at the right time and avoid waste of steam in doing station work requires proper firing and handling of a locomotive, and the closest co-operation between the engineman and fireman. The Missouri-Kansas-Texas has been making a special effort for a number of years to develop experienced engine crews with the required knowledge and ambition to work together in saving locomotive fuel, and this is doubtless an important factor in such records as that cited above.

Railway correspondence

Recently, a master mechanic stated that the more quickly his subordinates fully appreciated the fact that correspondence which went out over his signature was generally in reply to letters from his superiors and should be promptly and properly answered, the better it would be for all concerned. Letters from superiors usually request information. Too often the subordinate from whom the information is requested takes the attitude that he has more important things to do than to dig up facts for the "boss." As a result, one or more follow-up letters have to be sent before the superior can get a reply. One of the fundamental rules in a business office is that all correspondence must receive prompt attention. Sometimes information is requested that requires considerable investigation. If such is the case, the subordinate should inform his superior to this effect but should not, in an effort to be prompt in his reply, supply information for the correctness of which he cannot vouch. Such a practice does far more harm than good. A subordinate, thorough in his methods, will supply his superior with the information requested which the latter can pass on as reliable without the necessity of additional correspondence.

Who oils your machines?

A new machine tool, just out of the builder's plant represents not only the expenditure of a considerable amount of money but also a productive potentiality over a period of years. The initial expenditure having been made, the productive capacity of this machine will be in direct proportion to the manner in which it is operated and maintained.

The improper lubrication of machine tools results in the wear of working parts, with a consequent increase in maintenance costs and loss of productive capacity through breakdowns. Modern machine tools show a tendency toward the use of force feed automatic oiling which to a great extent removes the possibility of human neglect. A great part of the machines in most shops are not equipped with such features and their continued successful operation depends upon faithful attention to the

lubrication of all working parts. Machine operators on piece work are quite liable to overlook the importance of this factor in their work.

The question as to who should be responsible for oiling shop machinery is an open one. Some shops hold the machine operator responsible while in others, the job is assigned to an apprentice. Merely oiling a machine, and doing it right, may not only help to keep down maintenance costs but also serve as a valuable part of an apprentice's education through the process of familiarizing him with the details of machine tool construction. It cost the railroads over 27 million dollars in 1925 to maintain shop machinery. If every machine had been properly oiled every day it is reasonable to suppose that a worth while part of this expense would have been saved.

Labor turnover and modern tools

A minimum of labor turnover is a desirable advantage. With the cost of hiring and losing an employee running anywhere from $20 to $250, it is an important step when a hard, disagreeable, job is changed into a comparatively easy and pleasant one. In one flue shop the method of safe ending and swedging flues was changed from the hot gas furnace method to the comparatively cool electric heating method. What were the results obtained? The shop force was reduced 62 per cent, owing to increased output and the workmen were so well satisfied, that the labor turnover was practically reduced to zero. The foreman spoke with pride of his shop and of his men. One of the advantages of modern machine tools is reduced labor turnover. Power rapid traverse, power elevation, push-button control, air chucks and other features that reduce the heavy manual work of machine operation are as surely lowering production costs by reducing labor turnover as they are by turning out the work in less time.

The draft gear—present and future

The question of what should be the requirements of a satisfactory draft gear for freight cars has been an important one for many years and has become more so with the increased number of 70-ton and larger capacity freight cars. There is a wide divergence of opinion among railroad officers as to the qualities that should be possessed by a satisfactory draft gear or what should be the ideal force-closure indicator card for a gear undergoing tests on a testing machine. This was repeatedly brought out in the discussion of A. F. Stuebing's paper on the development and testing of draft gears which was presented at the January 31, 1927, meeting of the Railroad Division of the American Society of Mechanical Engineers, in New York.

Although many draft gear studies and tests have been made under the direction of the Master Car Builders' Association and later of the Mechanical Division of the American Railway Association, no agreement has yet been arrived at as to the ideal characteristics of a draft gear. Much was hoped for and expected of the draft gear tests made under the direction of the Railroad Administration during the period of federal control but, as was brought out in Mr. Stuebing's article on the operation and testing of draft gears, in the January, 1927, issue there was considerable difference in the results recorded in the laboratory drop tests and those recorded in the speed-impact tests.

The draft gear manufacturers claim that they can design their apparatus to cover almost any reasonable requirement within the limitations imposed by the space available. They could, however, design a better gear for large capacity cars if the present standard pocket dimensions were increased. This applies particularly to the length, to which the least objection can be offered, as there is considerable unused space back of the present standard draft gear pocket.

The American Railway Association should give careful consideration to the limitations imposed on the draft gear designer by the present size of the standard pocket in connection with the draft gear tests at Purdue University. The draft gear requirements of the 70-ton and larger capacity car need special study and no time should be lost in making and digesting these tests so that requirements may be recommended to which the manufacturers can be asked to comply. If present standards stand in the way of obtaining a better draft gear, those standards should be changed. In any case, the requirements established must be such as to take care of the needs of the future as well as those of the present.

Boiler capacity and horsepower

The new 2-6-4 type locomotive which has just been placed in service by the New York Central, and a description of which appears in this issue, marks another step in the trend toward increasing the horsepower capacity which can be developed with a given number of coupled wheels. The developments in this direction which are already familiar have been in freight power and are represented by the Lima 2-8-4 type, the Texas & Pacific 2-10-4 type, the 4-10-2 type of the Southern Pacific and Union Pacific, and the 4-12-2 type of the latter railroad, in each of which a pair of trailer or truck wheels has been added to the customary wheel arrangements of freight locomotives in order that more boiler capacity might be built into them. In this case it is the 4-6-2 type locomotive the horsepower capacity of which it has been the purpose to increase. Some idea of the extent to which this has been accomplished may be obtained by comparing a few of the proportions of this locomotive with the proportions customarily attained in 4-6-2 type locomotives.

The principal difference in the proportions of the boiler itself, between this locomotive and 4-6-2 type locomotives arises from the use of the Type E superheater. This results in a total superheating surface which amounts to 43.8 per cent of the total evaporating heating surface. The corresponding percentage for the Type A superheater varies in different Pacific types from a little less than 20 to approximately 28 per cent. What these ratios do not show is that the change in distribution is not at the expense of evaporative heating surface, but on the contrary, is accompanied by some increase of evaporative heating surface and, of course, a much larger increase in combined heating surface, than is obtained with an equivalent Type A superheater tube sheet layout.

Two other ratios, representing the proportions of the boiler itself, may also be of interest. These are the ratios of evaporating heating surface to grate area and of combined heating surface to grate area. For the 2-6-4 type locomotive the first ratio is 55, as compared with an average of approximately 60 for Pacific type locomotives. In the case of the second ratio the figure is 79.3 for the 2-6-4 type, which is among the highest of the figures for representative Pacific type locomotives. The difference in the two comparisons is, of course, the result of the marked increase of superheating surface effected by the use of the Type E superheater.

A comparison of the boiler capacity with the cylinders,

however, shows where this locomotive has the advantage in the development of horsepower. Such a comparison may be roughly based on the well-known ratio of tractive force times diameter of drivers to combined heating surface, sometimes known as the boiler demand factor. For the new 2-6-4 type locomotive, this is 519, whereas few 4-6-2 types, at all comparable in weight and starting tractive force, have been built for which this ratio is less than 600 and for some of them it runs over 700. These figures may be considered to represent the relative amount of cylinder tractive force (irrespective of driving wheel diameter) for each square foot of combined heating surface.

Another comparison of the relationship of the boiler to the cylinders should also be considered along with the heating surface. This is the ratio of tractive force times diameter of drivers to grate area. This, in reality, shows the amount of cylinder tractive force (irrespective of driving wheel diameter) for each square foot of grate area, and the comparison should give some indication of the relative ability of various locomotives to sustain high tractive forces at high speeds without excessive combustion rates. For the new 4-6-4 type this ratio is 41,100. Several 4-6-2 type locomotives have been built for which this ratio is in the neighborhood of 45,000. Quite commonly, however, it exceeds 50,000. All of these ratios, considered together, indicate clearly that the additional trailer wheel in the 4-6-4 type locomotive has very materially increased the boiler capacity in relation to the cylinders, but that this increase is proportionately greater in the case of heating surface than in the case of grate area. Adding the advantage of a feedwater heater and of a boiler pressure of 225 lb. per sq. in., this locomotive may be expected to develop a very material increase in horsepower over the heaviest Pacific types, some of which have equal cylinder sizes and greater weights on drivers.

A rational specification

The use of specifications in the purchase of materials, tools and many kinds of equipment has become so general that few commodities are now purchased by railroads except under specifications, where the materials or equipment lend themselves at all to the development of specifications. These specifications may be divided roughly into two groups. In one group the chemical and physical characteristics of the material, methods to be employed in its manufacture, etc., are set down in detail. In the other, the conditions of application or use to which the subject of the specification must be adapted and the performance or durability results which it must produce, are the criteria by which it is to be accepted or rejected. There are, of course, specifications which combine the characteristics of both groups. In discussing the merits of the two types, generalizations must be made with caution because the character of materials and the conditions under which they are to be used vary so widely. There are conditions of use which are such that no simple tests can be applied to determine whether or not they will be met by the material under consideration, and in such cases recourse must be had to the type of specification which describes the kind of material which experience has demonstrated will best meet the requirements. But wherever service tests can be developed simple enough to be practicably applied each time a purchase is made, the opinion may be ventured that the second type of specification is the better of the two when the interests of both the buyer and seller are considered. While in no way relieving the producer from responsibility for the quality of his product, it gives him unlimited scope for the exercise of ingenuity and invention in the development of new combinations and processes for the improvement of the quality and the reduction of the cost of the product. Under the first type of specification, the producer's freedom of action in this regard is curtailed and the development of the art involved in the creation of the product is likely to be slowed down. An interesting example of what may be done in working out specifications of the second type will be found in an article on another page in this issue. It describes how a simple and easily applied set of shop tests was developed to measure the serviceability of hack saw blades. The principles applied in these tests may be suggestive of other products which can be purchased in a similar manner.

New Books

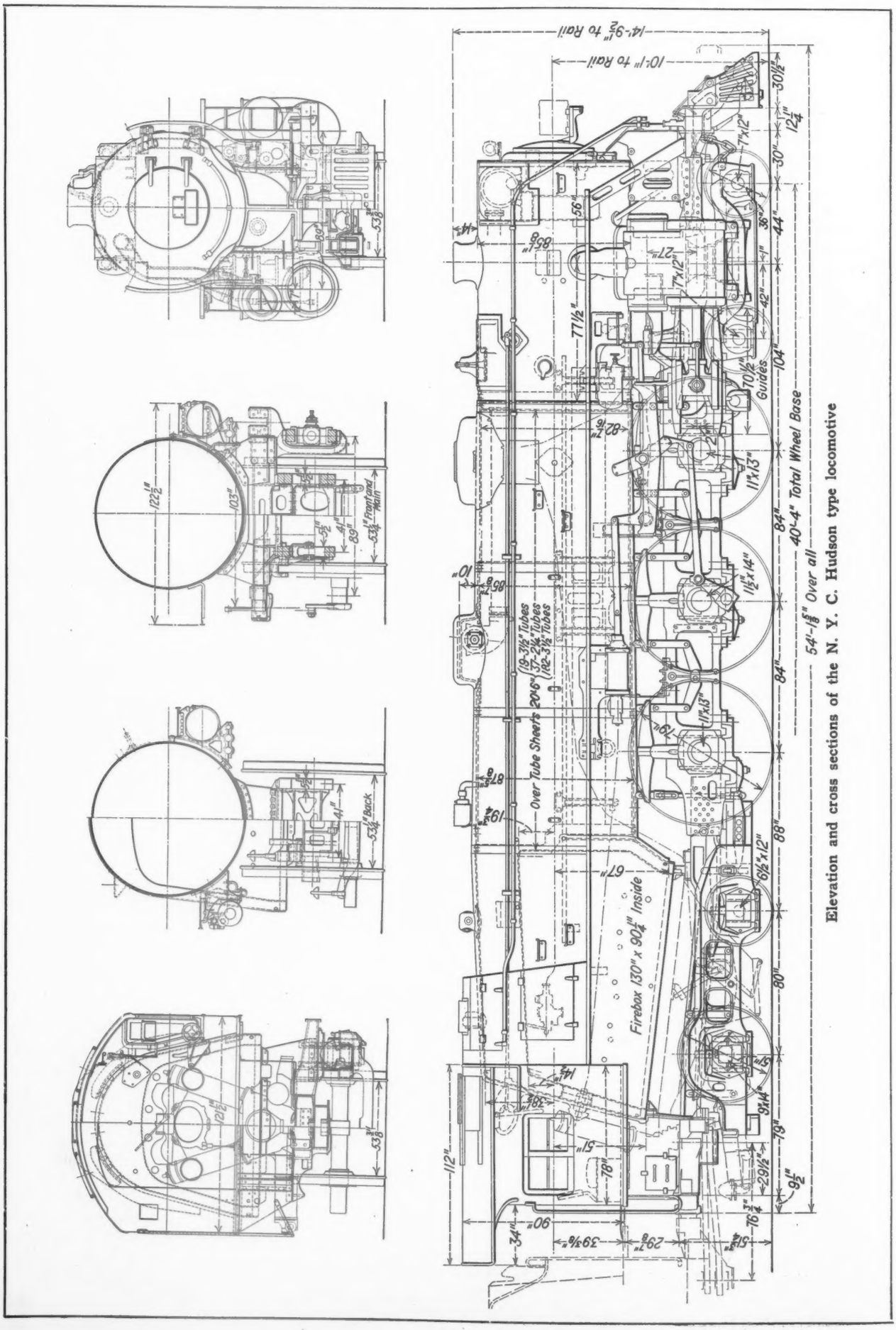
PATENTS, WHAT A BUSINESS EXECUTIVE SHOULD KNOW ABOUT PATENTS. *By Roger Sherman Hoar, M.A., L.L.B., head of the patent department of Bucyrus Company, South Milwaukee, Wis. Bound in cloth, 6 in. by 8½ in., 232 pages. Published by The Ronald Press Company, 15 East 26th street, New York. Price* $4.50.

This book, written by Roger Sherman Hoar, author of "Hoar on Constitutinoal Conventions" and other works on law and engineering, contains a large number of suggestions for getting a patent through the patent office, protecting it from infringement and using legal advice to the best advantage. It outlines a policy which experience has shown will protect a company or individual from loss of patents which quite often occurs through being outmaneuvered by a competitor. The author has taken a strictly business viewpoint, which is necessary in practical commercial and financial affairs. He has undertaken to correct the many false notions generally held by those concerned with patents and has summarized a number of popular misconceptions and contrasted the truth in each case.

TOOL CONTROL, PROCUREMENT, STORAGE, ISSUE, USE, REPAIRS AND COST. *By Anker L. Christensen, M.B.A., engineer, tool and material storage department, Worthington Pump and Machinery Corporation, Harrison, N. J. Bound in cloth, 6 in. by 8½ in. 134 pages, illustrated. Published by The Ronald Press Company, 15 East Twenty-sixth street, New York. Price* $3.50.

The author has stated in the preface of this book that, "Its purpose is not to break new ground in the sense of evolving new theories, but rather to apply the accumulated knowledge and experience on the subject to a specific problem; namely, the installation of an efficient tool control system, which will adequately and economically cover the requirements of large factories and yet be elastic enough to suit the needs of smaller ones."

None of the various applications and systems described in the book directly apply to railroad shop work. There are, however, a number of chapters on such subjects as making a preliminary analysis of tool room requirements, tool classification, bringing tools under control, methods of issuing tools, tool inspection and tool room personnel, that many railroad shop supervisors could study to advantage. The tool room is probably one of the most neglected departments in the average railroad shop. Yet, its successful functioning has a considerable influence on the production of the shop as a whole, especially as to the quality of work turned out.—M. B. R.



Elevation and cross sections of the N. Y. C. Hudson type locomotive

Hudson type locomotive on N. Y. C.

First 4-6-4 type is designed for heavy, fast passenger service—Built by American Locomotive Company

THE first locomotive of the 4-6-4 wheel arrangement to be built in America has been placed in service by the New York Central following ceremonies at Schenectady, N. Y., on February 14, at which time it was formally delivered to the railroad by the American Locomotive Company and christened the "Hudson" type. The four-wheel trailer of the new locomotive permits the development of a material increase in boiler capacity and in maximum horsepower output in a six-coupled driving wheel base over that obtainable in a Pacific type. The locomotive will be used in high speed main line passenger service on the Twentieth Century Limited, the Empire State Express, the Southwestern Limited, the Detroiter and other important passenger trains where its added starting and horsepower capacity will permit a reduction in the number of sections of some of these trains which it is necessary to run with the present heavy Pacific type motive power.

The locomotive presents a clean appearing front view

The engineering in the design of the Hudson type locomotive represents a disinct achievement in a number of features through the co-operative efforts of the equipment engineering department of the railroad and the engineering department of the builders. The locomotive develops a maximum rated tractive force of 53,500 lb., including 10,900 lb. supplied by the booster, which represents a substantial increase in tractive force over the present Pacific type locomotives now handling the heavy fast passenger trains. With cylinders 25 in. by 28 in., operating at nominal full stroke cut-off, 79-in. driving wheels and a boiler pressure of 225 lb. per sq. in., this tractive force is developed with a total weight on drivers of 182,000 lb., or slightly more than an average of 60,000 lb. per pair. The total weight of the locomotive is 343,000 lb., of which 63,500 lb. is on the engine truck and 97,000 lb. on the four-wheel trailer truck. In the development of the design, extreme care was taken in the distribution of wheel loads and in keeping down the weight of material in machinery parts in order that rail and bridge stresses might be kept to a minimum as an aid to safety of operation and economical track and roadbed maintenance.

In the design of the boiler the additional capacity of the four-wheel trailing truck was utilized to increase both the size of the firebox and the boiler capacity. It includes a Type E superheater with 1,965 sq. ft. of heating surface which added to the 4,491 sq. ft. of evaporating surface, gives a total of 6,456 sq. ft. of heat transferring surface. The firebox has a grate area of 81½ sq. ft. and is fitted with cast steel grate bars which accounted for a substantial reduction in weight. The boiler is fired by a D-3 Duplex stoker. A Commonwealth cast steel ash pan is applied.

The arrangement made for the location of the Elesco feedwater heater below the top of the smokebox shell is of unusual interest, in that it effects a material improvement in the appearance of the locomotive. The heater is supported on a shelf welded into the top of the smokebox just back of the front end door ring. With the heater in place, the opening over the shelf is closed with plates which complete the circle of the front end so that only the ends of the heater are exposed beyond the curve of the smokebox shell. The appearance of the locomotive is further improved by enclosing the pipe connections to the heater in conduits which pass down through the smoke box and are welded to the heater shelf at the top and to the smokebox sheets at the bottom.

The locomotive is equipped with the American type multiple disc throttle, the valves of which are housed in the superheater header casting. A removable cover plate over the top of the smokebox back of the stack permits access to the superheater unit bolts and the throttle valves without entering the front end.

The cylinders are of cast steel with inside exhaust passages. They have been arranged so that during dynamometer tests the possible advantages of limited cut-off in high speed passenger service may be investigated.

Among the machinery details the four-wheel Commonwealth Delta type trailing truck is of greatest interest. This follows the principles of suspension and weight distribution of the well-known Delta type two-wheel trailer truck, with the driving wheels and both trailing truck wheels on each side of the locomotive equalized together. The design is worked out in combination with the standard inside cradle casting, per-

mitting the tractive force of the engine to be transmitted through the cradle extension of the main frame system to the engine and tender drawbar. The front wheels of the trailer truck are 36 in. in diameter. The rear wheels which carry the Type C-2 booster, are 51 in. in diameter.

The locomotive is equipped with Alco main driving boxes. These boxes are fitted with supplementary bearings on each side below the center line of the axle which are securely held in position against shoulders on the lower edges of the crown brass by wedges. The engine trucks are fitted with the locomotive company's quick packing cellars which are readily accessible from the inside for repacking without the necessity of dropping the cellars.

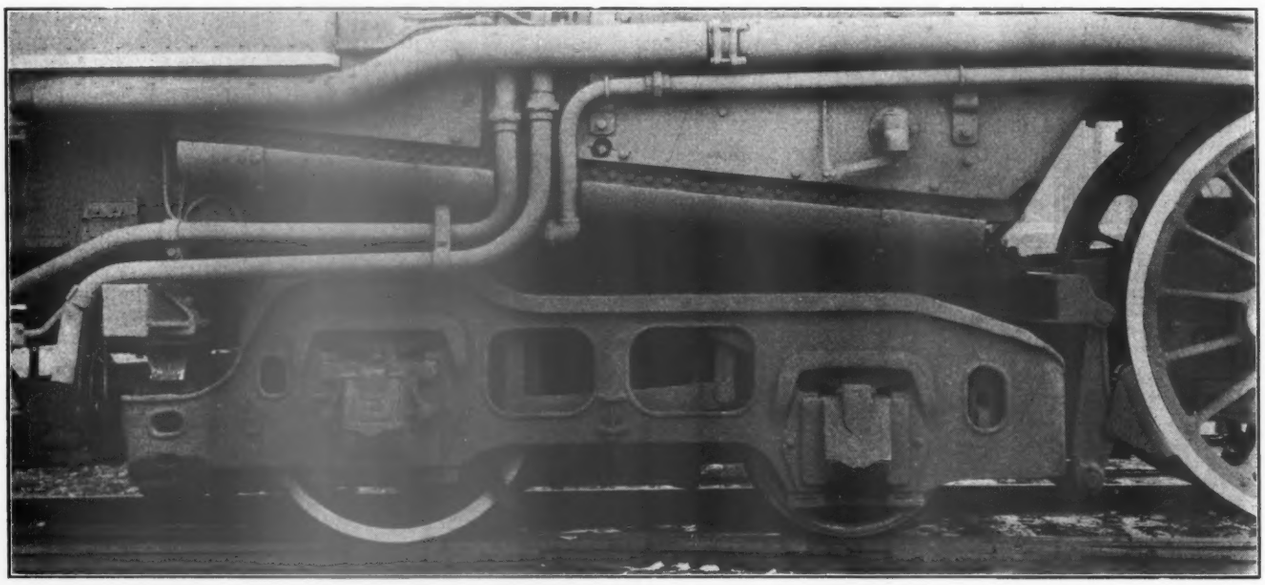
Steam distribution is controlled by the Walschaert valve gear and a Precision reverse gear. The valve gear is designed for long travel.

Care has been taken throughout the design to reduce to a minimum the number of supporting bracket details and the number of studs in the boiler from which these brackets must be supported. On the left side of the locomotive a combined bracket and pipe clamp supports the main reservoir and the booster throttle valve. Similarly, on the right side the reverse gear cylinder and distributing valve are supported by a single bracket, as have also the force feed lubricator and the feedwater heater condensate trap, just back of the cylinders.

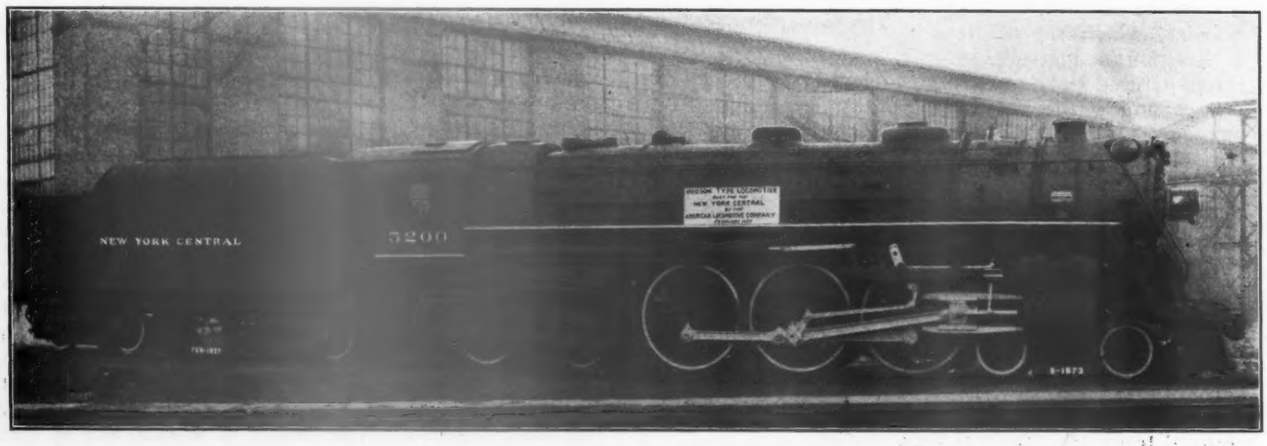
A number of locomotives have been built with the air pumps located back of the front bumper bracket, under the smokebox. In this case the locomotive is equipped with one cross compound air compressor which is located under the smokebox on the right side of the locomotive while the feedwater pump is similarly located on the left side. This location permits a free flow of water from the tank to the pump and a short delivery from the pump to the feedwater heater drum. Provision has been made on the left side of the locomotive for the application of the feedwater pump, however, should it later become desirable to add a second air compressor.

A pleasing feature of the appearance of the locomotive is the result of the care which has been taken in locating the piping to prevent irregular lines along the outside of the boiler jacket. The sand pipes and traps are located under the jacket and all other pipes have been placed in as inconspicuous locations as possible and, where visible, the arrangement adheres to horizontal and vertical lines with few exceptions.

Similar care has been taken in the arrangement of the cab fittings. All steam pipes and valves as far as possible have been kept outside the cab under a turret hous-



The Commonwealth four-wheel Delta trailer

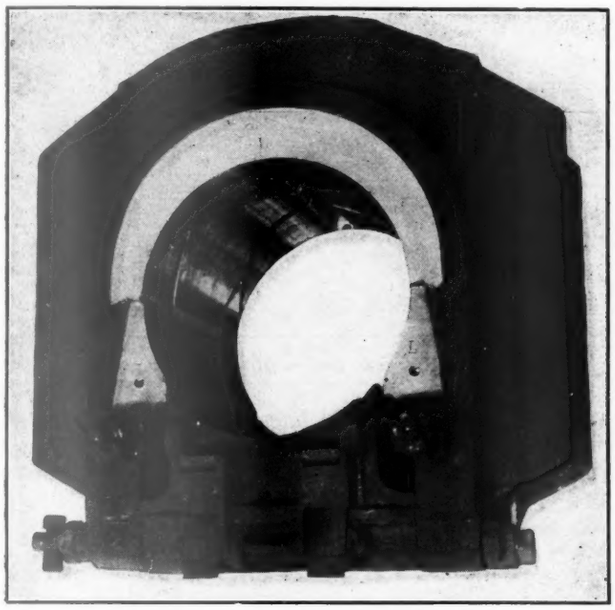


The first Hudson type high-speed passenger locomotive, now in service on the New York Central

ing over the top of the boiler in front of the cab. The steam valves in the turret are operated by extension handles which pass back through the cab wall, where they are arranged in a neat line across the top of the firebox on an instrument board, with each handle clearly labelled. With the exception of the air and back pressure gages, all of the gages in the cab have also been assembled on the instrument board.

Among special equipment not heretofore mentioned are the G. R. S. automatic train control, Nathan force feed lubricator, Graham-White sanders, the Pierce bell ringer, and air operated whistle.

As a result of the co-operation of the builder's entire organization the locomotive was built in an unusually short time. The boiler was received on the erecting floor on January 28, the main frames on February 1 and the cylinders on February 2. The locomotive was steamed, weighed and given its trial run on February 8, and completely finished and painted on February 9. No efforts,



The main driving box has supplementary bearings

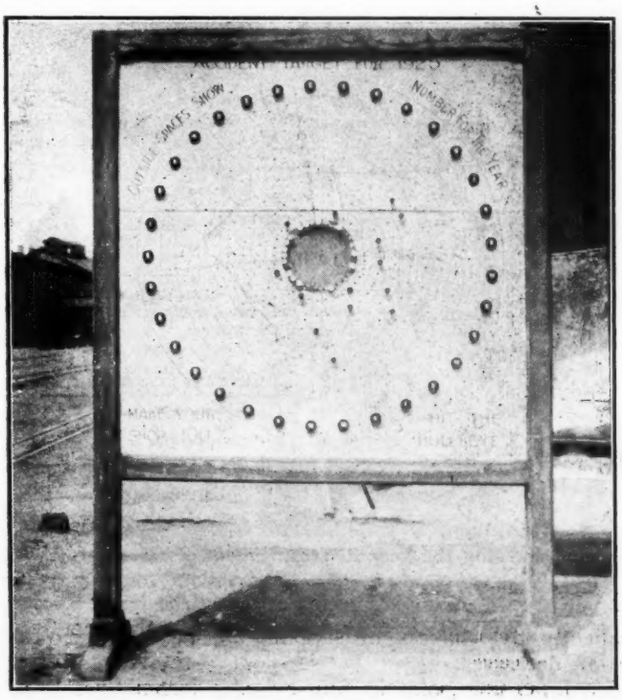
however, were spared to provide a high standard of workmanship throughout.

The New York Central will subject the New Hudson type locomotive to complete dynamometer tests to determine under actual operating conditions the efficiency of the entire machine and to reveal any possibilities for further improvements.

The table gives the principal dimensions, weights and proportions.

Table of dimensions, weights and proportions of the Hudson type locomotive

Railroad	New York Central
Type of locomotive	4-6-4
Service	Passenger
Cylinders, diameter and stroke	25 in. by 28 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	9 in.
Steam lap	1 7/8 in.
Exhaust clearance	¼ in.
Lead	3/8 in.
Cut-off in full gear, per cent	86
Weights in working order:	
On drivers	182,000 lb.
On front truck	63,500 lb.
On trailing truck, front wheels	44,000 lb.
On trailing truck, rear wheels	53,500 lb.
Total engine	343,000 lb.
Tender	209,000 lb.
Wheel bases:	
Driving	14 ft. 0 in.
Rigid	14 ft. 0 in.
Total engine	40 ft. 4 in.
Total engine and tender	76 ft. 1½ in.
Wheels, diameter outside tires:	
Driving	79 in.
Front truck	36 in.
Trailing truck, front wheels	36 in.
Trailing truck, rear wheels	51 in.
Journals, diameter and length:	
Driving, main	11½ in. by 14 in.
Driving, others	11 in. by 13 in.
Front truck	7 in. by 12 in.
Trailing truck, front	6½ in. by 12 in.
Trailing truck, back	9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	225 lb.
Fuel	Bituminous coal
Diameter, first ring, inside	82 7/8 in.
Firebox, length and width	130 in. by 90¼ in.
Height mud ring to crown sheet, back	65½ in.
Height mud ring to crown sheet, front	86¾ in.
Arch tubes, number	4
Combustion chamber, length	None
Tubes, number and diameter	19, 3½ in. 37, 2¼ in.
Flues, number and diameter	182, 3½ in.
Length over tube sheets	20 ft. 6 in.
Grate type	Cast steel
Grate area	81.5 sq. ft.
Heating surfaces:	
Firebox	253 sq. ft.
Arch tubes	35 sq. ft.
Tubes and flues	4,203 sq. ft.
Total evaporative	4,491 sq. ft.
Superheating	1,965 sq. ft.
Comb. evaporative and superheating	6,456 sq. ft.
Tender:	
Style	Water bottom
Water capacity	10,000 gal.
Fuel capacity	18 tons
General data estimated:	
Rated tractive force, 85 per cent, engine	42,400 lb.
Rated tractive force, booster	10,900 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	53
Weight on drivers ÷ tractive force	4.3
Total weight engine ÷ comb. heat. surface	53.1
Boiler proportions:	
Tractive force, engine ÷ comb. heat. surface	6.6
Tractive force, engine × dia. drivers ÷ comb. heat. surface	518.8
Firebox heat. surface ÷ grate area	3.5
Firebox heat. surface, per cent of evap. heat. surface	6.4
Superheat. surface, per cent of evap. heat. surface	43.8



Safety board installed at the Southern Pacific shops, Sacramento, Cal.—The white pegs around the bull's-eye indicates a shop having no accident during the month

The Caprotti poppet valve gear*

Description of application to a four-cylinder compound locomotive by the Italian State Railways

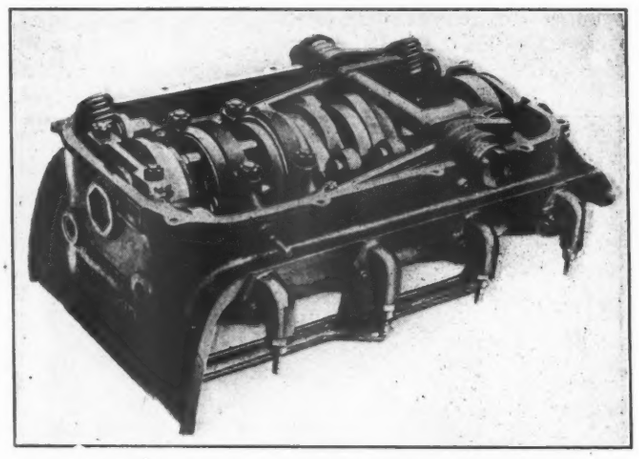
By A. Caprotti
Milan, Italy

THE limitations of the steam locomotives are mostly due to steaming capacity and the unevenness of both starting and turning torques. The former limitation can be partially overcome by increasing the boiler capacity or, better still, by improving on the steam consumption per unit of power, and this object has to some extent been accomplished by the adoption of superheaters and feed-water heaters. But a further advantage can still be obtained by improving the steam cycle of the engine. The arrangement of the crank setting in a four-cylinder locomotive to give eight beats per revolution ensures a more even turning moment and at the same time improves the draft in the firebox and consequently the combustion and boiler efficiency. The writer has worked out the problem on a locomotive of the Italian State Railways, and will show how the angularity effects on the balancing can be corrected with practically the same accuracy as the ordinary arrangement in general use.

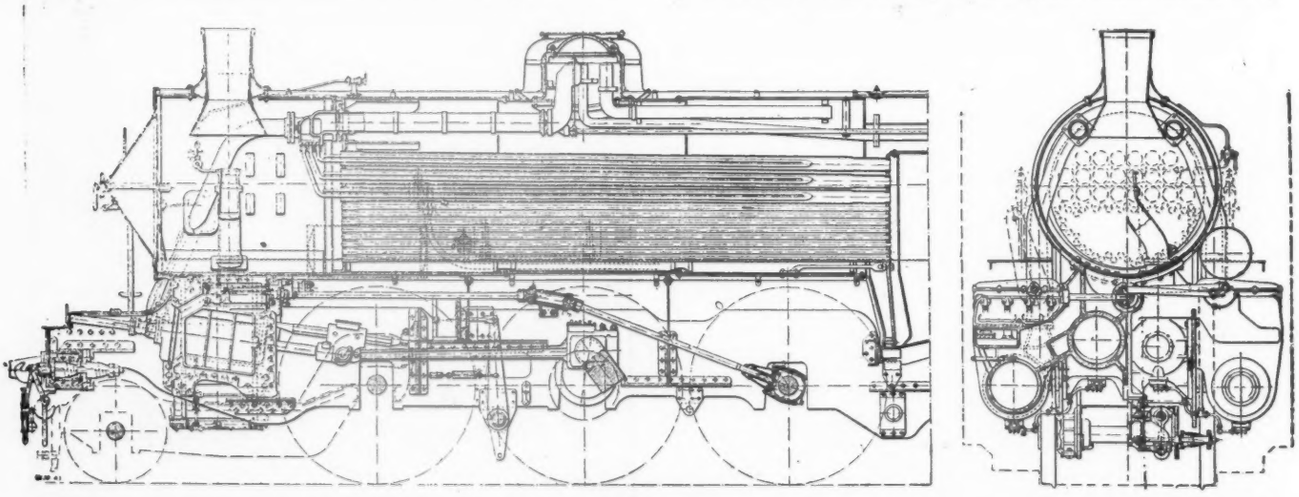
With four cranks arranged at 135 deg. the maximum crank effort in excess of the mean can be reduced to 6½ per cent; in a three-crank locomotive the same value is 7½ per cent, so that the four-crank arrangement is even more effective in hauling fast trains on a small adhesive weight.

A doubt may arise that with the steam locomotive at shorter cut-offs slipping may occur more frequently, the ratio between the maximum and the mean torque being greater. But it must be remembered that the maximums in this case are lower in their absolute value, and consequently the chances of slipping are decreased as the cut-off decreases.

An important point in four-cylinder locomotives is to divide the power equally between the cylinders, the two twin single-expansion superheated steam engines being, in this respect, superior to compound engines. The writer ventures to state that by using the gear described in the following paragraphs, which allows a proper single expansion of steam from the latest to the earliest cut-offs with proper advances for admission and exhaust and proper compression, avoiding wire-drawing of steam by rapid opening and closing of the ports, there would be no reason for using the compound engine, especially if high superheating be adopted as permitted by the use of poppet valves.



View of the gear box with the top removed



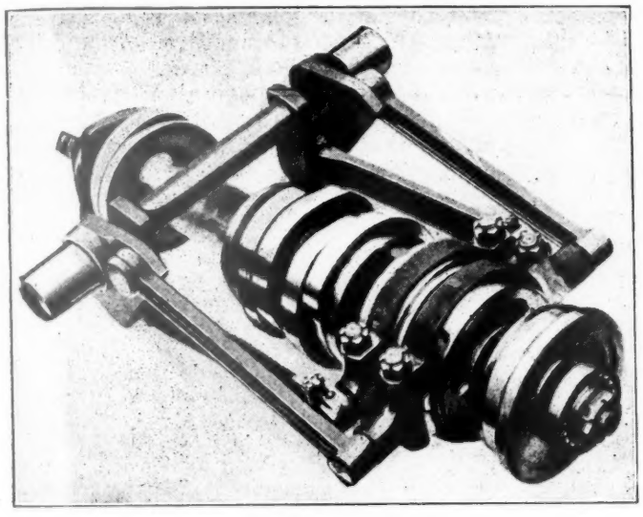
Drawing showing the general arrangement of the Caprotti valve gear as applied to a 2-6-0 four-cylinder compound locomotive on the Italian State Railways

The compound locomotive

The compound locomotive was developed at a time when superheated steam was not appreciated or extensively used,

*Abstract of paper read before the Institution of Locomotive Engineers, Glasgow, Scotland, Nov. 27, 1924.

and the chief objects of compounding were: first, to reduce the losses through condensation of live steam on the cylinder walls; and second, to provide a greater range of expansion when employing the ordinary link valve gear, which can only work conveniently with a high or moderate cut-off. With a cylinder volume ratio of 1 to 2.4 between high pressure and low pressure, a cut-off of 35 per cent in the high pressure cylinder would correspond, referred to the low pressure cylinder, to an actual cut-off of 15 per cent. Now this latter cut-off would give a rather poor diagram in a single cylinder with the usual link motion slide valve gear, while with a cut-off of 35 per cent, the steam action is utilized to the best advantage. By stage expansion of steam, the thermodynamic loss due



The cam shaft

to condensation is greatly reduced, owing to the smaller difference of the mean temperatures of the cylinder walls between exhaust and admission. The condensed steam, besides, may be re-evaporated during the exhaust phase of the high pressure cylinder and can develop a certain amount of work in the low pressure cylinder.

Against these points in favor of compound working, stands the loss due to the pressure drop between the exhaust of the high pressure cylinder and the admission in the low pressure cylinder, also other losses due to various causes such as wire-drawing of steam and friction in the angles and ducts. This loss in saturated steam engines is rather high, with the usual boiler pressure it is no less than 14 lb. per sq. in., or about 10 per cent of the steam chest pressure. It is, however, always lower than the above mentioned losses through condensation and this justified compounding.

Compound locomotives have all more or less special drawbacks of a mechanical nature which should not be overlooked. With the exception of symmetrical four-cylinder compounds, the load cannot always be divided equally between the low pressure and high pressure cylinders and even with symmetrical compounds the starting valve, which adds to the complication of design, cannot be avoided.

The unequal division of load and the poor starting qualities of the locomotive are specially felt in unsymmetrical compound engines, having both high pressure cylinders on one side and both low pressure cylinders on the other side. The apparent simplicity in having only one piston valve to each pair of cylinders is obtained at rather high cost. These locomotives are, even more than the former, subject to a racking strain in the frame as the tendency of the wheels to lead on the side where the turning effort is greatest, causes excessive friction and wear on the wheel flanges and higher upkeep expenses.

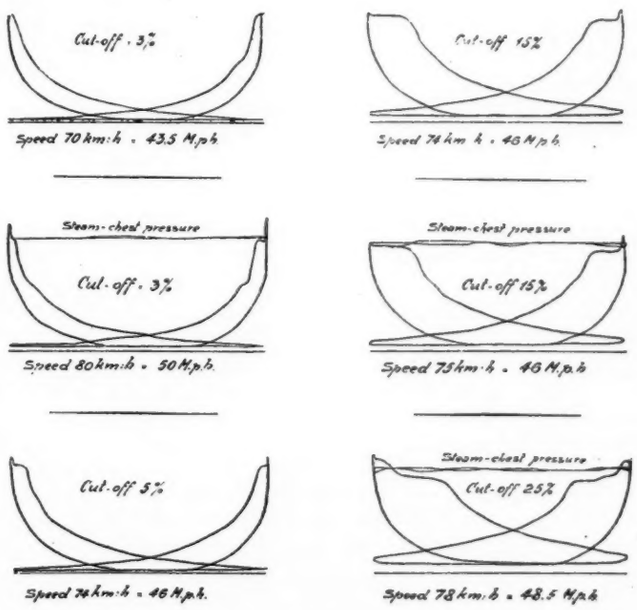
Proper superheating renders compounding superfluous

At present, owing to the almost general adoption of superheaters, the problem of the multiple expansion of steam has to be considered in a different way. With superheated steam, condensation and its inherent thermal losses are avoided. But there remains the loss due to the exchange of heat between the steam and the cylinder walls and there also remains unaltered the pressure drop between the high pressure exhaust and the low pressure admission, so that the only advantage left would be the higher range of expansion. Now if a gear such as that described in this article can be adopted giving the same high range or even higher ranges of expansion in a single cylinder, compounding becomes unnecessary.

The Caprotti poppet valve gear

The gear which satisfies the above conditions has been evolved and has been tested successfully by the writer. It solves not only the 135 deg. four-crank problem, but the general problem of the best utilization of heat within the actual limits of temperature and pressure of steam employed, just in the same degree as it is obtained in stationary steam engines of the most economical type.

This gear is a cam-operated drop valve gear manipu-



Indicator cards taken from a locomotive equipped with the Caprotti poppet valve gear—Cylinders, 16.53 in. by 25.59 in.; drivers, 71 in. in diameter

lated through the usual reverse lever in such a way that on notching up, the cut-off may be reduced from full gear to a minimum of about 5 per cent, without varying appreciably the lead of the admission. On throwing the lever over to full reverse, the setting of the cams is such as to be ready for the reverse motion with full gear.

The valves

Each poppet valve forms a self-contained unit with its cage and is fitted on the upper part of the cylinder by simply pressing into a conical chamber and screwing down a four-bolted flat cover. They can be easily taken out and

inspected in case of need. The valves are made of chrome nickel steel and are machined from solid forgings.

The poppet valves act as drop valves and are double seated, the lower seat being flat and the upper conical, with its summit lying in the plane of the flat face. This arrangement secures a steamtight closure at all temperatures, as any isotropic expansion of the valve or seat follows the law of geometric similarity. The valves made in this way are perfectly steamtight at high temperatures, even when they are lapped while cold and out of the cylinder. The admission valves are placed side by side towards the side frame. The exhaust valves are placed parallel to the latter at a fixed distance, allowing the gear box to be placed between them. The gear acts on the valves through levers projecting from each side of the box and the end play is taken up by regulating the height of the valve spindle.

The gear box

The number of cams for two admission and two exhaust valves is reduced to a minimum of three, one cam controlling the opening and the closing of both exhaust valves. Both inlet valves are controlled by a pair of cams having equal fixed profiles which on being shifted angularly, the one relatively to the other, act on a roller fitted beam which is attached to one end of a bell crank lever operating the admission valve. The effect is the same as if a variable profile cam were employed acting on a single roller borne by the same bell crank.

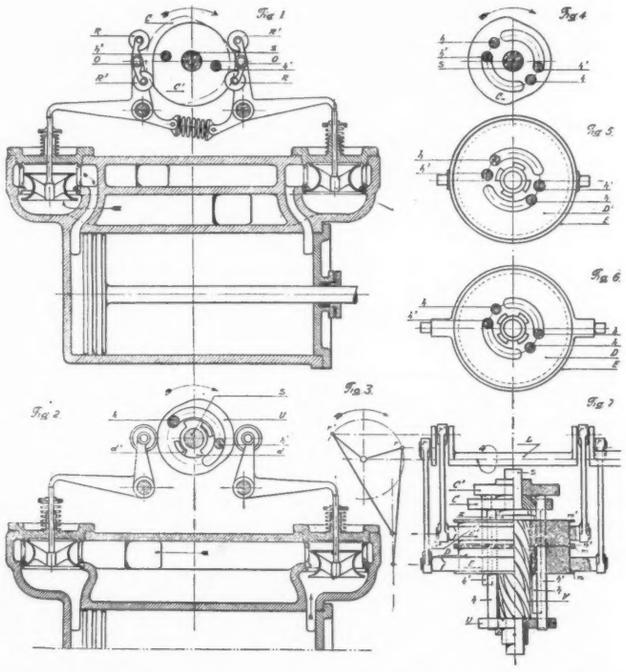
The cam shaft is placed crosswise between the fore and aft valves. The rollers of the bell crank levers bear symmetrically on the cams 180 deg. apart, while the outer end of the bell crank acts on the stem. The motion of the levers, and consequently of the stems of both admission and exhaust valves will be followed by one half revolution on each side of the piston alternately, thus solving by the simplest means the question of operating the valves. In the case of the single exhaust cam, the corresponding exhaust valve events remain constant but can be arranged, as to timing and angular lead, according to the working conditions of the engine, by simply changing the profile of the cam.

In the double admission cam, the phase event can be changed and controlled at will by simply moving the reverse lever. Of the two cams, when the locomotive is running in a given direction, one controls the opening and the other the closing of both admission valves, and on reversal of direction the functions of both cams are exchanged. For this object the above mentioned roller fitted beams have each, one roller bearing on one of the cams and the other roller on the other cam, the movement given to the end of the bell crank lever being the combined motion of the two rollers of each beam. The rollers of the two beams bearing on the same cam are 180 deg. apart, so that in this case the valve events on both sides of the cylinder follow each other by half a revolution.

The fact of having one roller bearing on the opening cam and the other on the closing cam, allows an independent timing of the opening and closing of the valves. If only the closing cam is shifted angularly forward in the direction of the rotation of the camshaft, the cut-off is varied while the lead of admission remains constant. As previously mentioned, the shifting of one of the admission cams relatively to the other has the same effect as varying the extension of the cam's profile. The extent of the shift is such as to allow quite an exceptional range of cut-off, from 80 per cent down to 5 per cent and even less, thus permitting a most complete expansion with a small cut-off without interfering with the other valve events. The exhaust, as explained above, can be timed according to the engine's requirements, but is kept constant, this having been found to be the best and simplest solution.

The exhaust cut-off happening always at the same angular position of the crank and the angular lead of the admission being constant in almost all running positions, the compression phase remains constant, so that the compression end pressure once chosen according to the requirements best suited to the engine, there is not danger of its rising above the pressure in the steam chest. The thermodynamical loss incurred, due to the pressure of the compression phase not reaching the admission pressure in the cylinder clearance space, is reduced to a low figure and the jerks due to reversal of stresses are completely avoided.

The camshaft rotates at the same speed as the driving axle of the engine. The general arrangement of the drive off the axle is shown in one of the illustrations. The telescopic shaft drives directly, or through a universal joint, a cross-shaft over the cylinder casting by a bevel group. This driving arrangement may vary to some extent with the design of the engine, but its chief elements can be



Application of the poppet valve to the cylinder of a locomotive

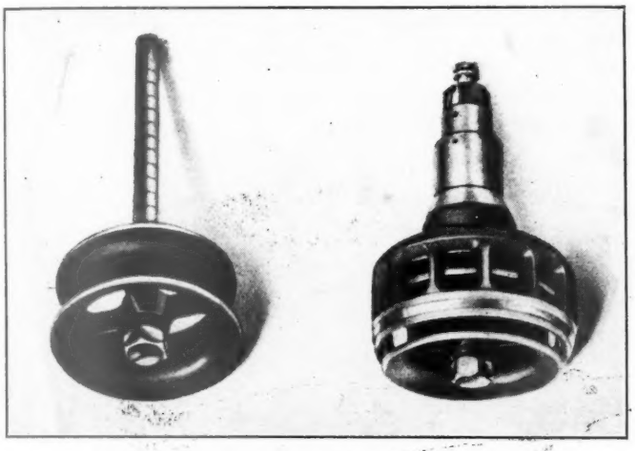
standardized. It can be made to run in oil and takes up very little power.

In order to understand clearly the construction of the gear we may refer to Figs. 1 to 7 which show the essentials of the gear in a two-cylinder gear box. On the cam shaft, shown in one of the illustrations, are seen the three cams, the exhaust cam, and the other two cams for controlling the admission. These cams are also shown in Fig. 1.

In the latter the compound motion is similar as regards mechanical detail to the crank lever action of the exhaust, only the single roller of the exhaust cam is replaced here by the two rollers on the pivoted beam. One roller makes contact with each cam so that the final movement transmitted to the admission valve is a combination of that of one roller on one cam and the second roller on the other cam.

The three cams are mounted loosely on the cam shaft

and are driven by dogs in the case of the exhaust cam (see Fig. 2) and for the others by rods fixed on the cams and parallel to the cam shaft (see Fig. 1). These rods engage in special sleeve discs (see Figs. 5 and 6) which can be shifted along a quick pitch screw cut in the cam shaft and consequently allow angular shift of both admission cams according to the parallel shift given to the discs along the screw. The longitudinal motion of the discs on the screw is obtained through two pairs of connecting rods and cranks which act on the annular collars fitted in a cylindrical groove cut out in the periph-



The poppet valve and cage

ery of the discs (see Fig. 7). These discs and rods form the control for the gear. By their combination with the double cam arrangement, it is possible to alter both the lead and the cut-off in either forward or backward motion.

The admission can be more or less advanced by varying the angular position of one cam, while the cut-off is varied by altering the angular position of the other cam. These two movements are secured by the controlling transverse crankshaft operated directly by the reverse lever in such a way as to provide for a small alteration of the position of one cam, the one controlling the opening of the admission valve, coupled with a large change in the position of the other cam, controlling the cut-off.

The relative angular shift of one admission cam with regard to the other is so designed that the cams exchange their functions on reversing, so that the cam controlling the opening of the admission valves takes up the closing of the same and the other cam controlling the closing takes up the opening of the same valves. Thus an exceptional range is provided for valve events. Starting from full gear in forward running, the cut-off is reduced to about 10 per cent, without altering the lead of admission. Then on notching further, the lead increases first slowly on reducing the cut-off from 10 to 5 per cent, and then more rapidly on passing to the counter steam until at full reverse the engine is ready to take up the reversed motion at full gear. The setting of admission is about the same for all locomotives so that no special cams are required. An important point in the gear is the reduced clearance spaces of the cylinder, which can be kept about 7.5 per cent of the cylinder volume and even smaller.

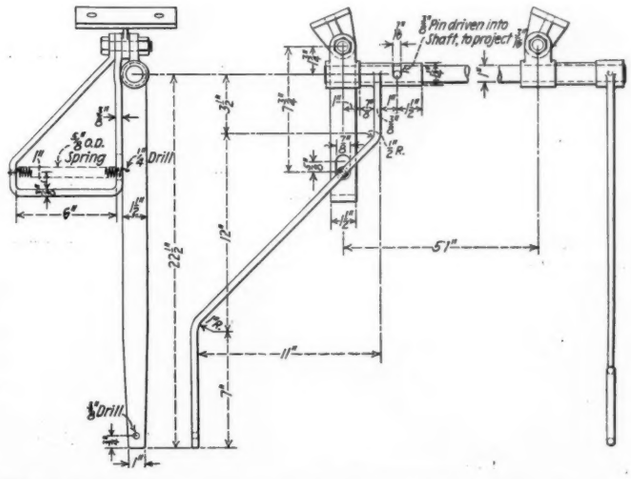
In four-cylinder engines, either twin single expansion or compound, only two gear boxes are necessary, one for each pair of cylinders. Each gear box contains two pairs of admission cams operated by two sleeve discs and two exhaust cams, all fitted loose on the same camshaft. Consequently the cams for each cylinder can be given a setting appropriate to the mutual crank setting, whatever this may be. With the new gear there is no bond obliging a special relative setting between the external and internal cranks in the four-cylinder locomotives, as happens with the reciprocating slide valve gear. The crank can be set at any angle best suited for the special requirements of the locomotive. For instance, for obtaining the torque most powerful in starting and most even running, or a more uniform distribution of beats per revolution so as to keep an almost continuous draft in the smokebox, even at low speeds. These two latter conditions are not contradictory and can be obtained with the 135 deg. setting of the driving cranks.

Arrangement of whistle lever for the fireman's use

By T. A. Foque

General mechanical superintendent, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.

THE rapid increase, during the past years, of automobile traffic over grade crossing has made it imperative that the fireman should have the proper facilities to sound the alarm when an emergency arises which does not permit him time to warn the engineman. The first experiment tried was to run a whistle cord to the fireman's



Whistle lever arrangement to permit operation from the fireman's side of the cab

side of the cab but it was frequently found that when the fireman wanted to use the cord it was knotted so badly as to make it inoperative.

This trouble was overcome by equipping the locomotive with a whistle lever arrangement such as shown in the accompanying illustration. It is designed so that the two levers can be operated independently of each other.

FUEL FOR ROAD LOCOMOTIVES in freight and passenger train service cost the Class I railroads $295,478,592 in the eleven months ended with November, according to the Interstate Commerce Commission's monthly compilation of railroad fuel statistics. The figures include only fuel charged to operating expenses and exclude switching service. The average cost of coal per net ton was $2.62, as compared with $2.72 for the corresponding period of 1925. For the month of November alone the cost was $2.72. The average cost of fuel oil for the eleven months was 2.94 cents, as compared with 3.16 cents in the corresponding period of 1925. For November the cost was 3 cents.

Gas-electric cars on the D. T. & I.

Two 150-hp. Hall-Scott engines, with Westinghouse generators, are carried under the car floor

THE Detroit, Toledo & Ironton placed two gas-electric rail cars in regular service last October, and each of these cars is now making 280 miles a day between Delray, Mich., and Bainbridge, Ohio, maintaining the schedule of former passenger trains No. 1 and No. 2.

The cars are 72 ft. 6 in. long, 14 ft. high above the rail, and 10 ft. 4 in. wide, weighing approximately 66 tons apiece. There are four principal compartments in each car. Next to the operator's cab, which takes up 3 ft. 6 in. in the front end, is a 15-ft. mail compartment; then comes a 14-ft. baggage compartment; a smoking compartment 8 ft. 10 in. long, containing three double seats on each side, and a passenger compartment 26 ft. in length, containing 17 double seats. The total seating capacity of the car is, therefore, 46. A vestibule at the rear is provided with a door at each side and one at the end for use when coupled to another car.

Aluminum alloy used extensively

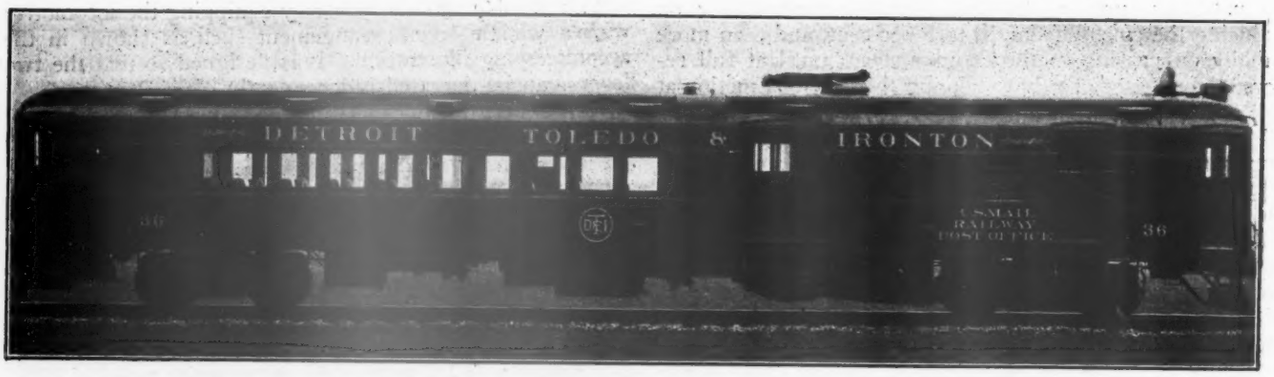
The underframe and car body are of steel construction, made to D. T. & I. specifications by the Pullman Car & Manufacturing Corporation. Aluminum alloy is used extensively in the construction of the cars. Furnished in sheets 1/16 in. thick, it covers the roof sheets of the upper and lower decks. The inside finish is aluminum; metal parts of the lighting fixtures are made of aluminum and are mounted on the lower deck sill about 6 ft. apart, and the conduit which encloses all wiring is also of aluminum.

The side, end and vestibule doors of the passenger compartment are made of Mexican mahogany, as are also the window sashes. The seats are of the stationary, low back, twin-seat type, upholstered in gray mohair plush. Seats in the smoking compartment, of similar construction, are upholstered in green Spanish leather. All trimmings are finished in statuary bronze metal finish, being painted to conform to the general scheme of decoration. The heating plant consists of a double coil, hot water system, with the heater situated in the baggage compartment and burning hard coal. A coupling at the side of the car adjacent to the heater is provided for connection to the steam line in yards and terminals.

Motive power is supplied by two Hall-Scott 150-hp. gasoline engines in each car furnished by the American Car & Foundry Motors Company, each direct-connected to the armature shaft of a Westinghouse 750-volt generator. The generators drive two box frame d.c. railway motors, each supplying power to one axle of the front truck.

The engines and generators are hung at each side of the car beneath the baggage compartment where they can be easily reached through steel coverings in the floor. To reduce vibration, the engines are arranged to rotate in opposite directions and, with the same end in view, the generators are bolted to a special support in which Spanish felt is used to absorb vibration. The front ends of the engines are attached by a link hanger

The front end of the car



The D. T. & I. gas-electric car with the power plants carried under the car floor

arrangement which allows for longitudinal expansion of the engine. A rubber cushion is used to absorb vibration at this point.

Each engine has six 5-in. by 7-in. cylinders and operates at a speed betwen 1,700 and 1,800 r.p.m. The

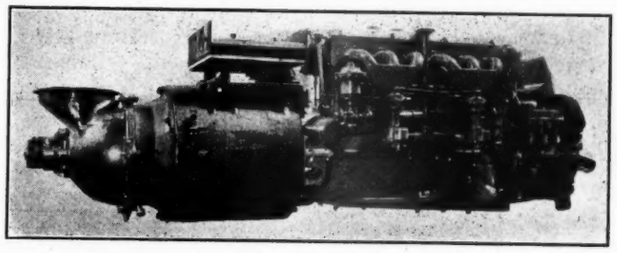
The main passenger compartment has 17 double seats

crank shaft, which is of chrome nickel steel, heat treated, is carried in seven main bearings 2¾ in. in diameter. The front bearing is 2⅞ in. long, the rear bearing 5 in. long, and the five intermediate bearings each 1⅞ in. in

the head. There is one intake and one exhaust valve per cylinder, the valves being placed at approximately a 32-deg. included angle to minimize restrictions and resistance to the gases and to aid turbulence. The compression chambers are machined all over. The valves are actuated by rocker arms which pivot on hardened shafts.

The cam shaft is supported by four bronze bearings 1⅛ in. in diameter, and the intake and exhaust valves for each cylinder are operated by the same cam. The cam shaft is driven by a silent chain direct from the front end of the crank shaft.

A force feed oil system of lubrication is provided for each engine, with suitable gages to indicate oil pressure.



The motor and generator set

A pressure of 50 lb. per sq. in. is carried at full load. Gasoline feed to the two carburetors is furnished by electrically operated Autopulse pumps. There are two symmetrical intake manifolds, each supplying three cylinders and each served by a separate carburetor. The intake manifold is partially heated by a flow of hot water from the cylinder head. The two exhaust manifolds are also symmetrical and each takes care of three of the cylinders.

The engine starter is on a 32-volt circuit operated by a solenoid switch controlled from the cab. Dual type ignition is used. There are two distributors, each with

Looking forward between the power plants, underneath the car

length. The cylinders are cast in a single rectangular block section. The barrels are cast integral with the water jackets and are cylindrical outside and free from bosses. The cylinder head is of deep section which insures rigidity for the cam shaft bearings, the cam shaft being carried longitudinally over the center line of

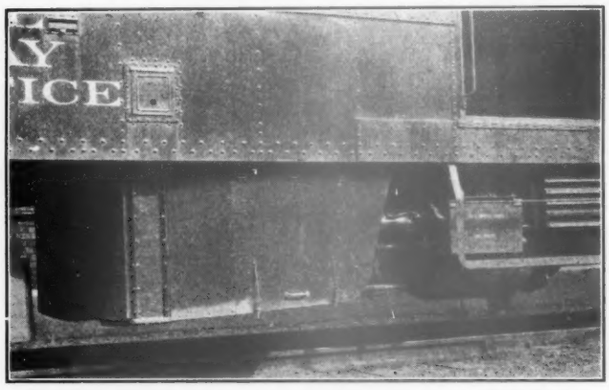
automatic spark advance, and a double set of spark plugs. The engine is water cooled and the radiator air cooled by a fan. The radiators are placed at the front end of the power plant housing and the fan is mounted on the front end of the crank shaft extension, running at engine speed. Exhaust from the engines is carried up

through the baggage room by a 3-in. pipe, with a muffler mounted on the roof.

The arrangement is such that both truck motors may be operated together or separately, an important advantage in the case of break-down of either engine and generator unit, in which event the remaining unit supplies the tractive force to four wheels instead of two. In an actual test the regular schedule speed was maintained for 60 miles with one motor running.

Two 32-volt batteries supply power for the starting motors and the lighting circuit. A 32-volt, 600-watt Leece-Neville generator is mounted on the air duct housing at the rear of each main generator, and is driven through a flexible coupling at engine speed. This generator supplies current for a 32-volt battery which takes care of starting requirements. The battery ignition system draws its current from a 12-volt battery which is charged from the 32-volt equipment through suitable resistance. The electrical equipment includes a 32-volt Leece-Neville starting motor, operating through a Bendix drive on each engine.

All power switches are of the pneumatic type remotely



The power plant housing contains the radiators at the front—The generators are shown at the rear

controlled from the driving cab through the master controller. An increase of engine speed is obtained by opening the throttle valve, both throttles being controlled by one valve and so adjusted that the speed of both engines is approximately the same at all positions of the throttle valve. This arrangement is designed to give a smooth and rapid acceleration and a flexible control at all car speeds.

Two fuel tanks hung beneath the car afford a fuel capacity of 366 gals. Benzol, a by-product of the Ford Motor Company operation, is used for fuel. Westinghouse brakes of the straight air type with emergency features and single end control are provided. A three-cylinder air compressor is mounted on the side of the crank case at the front end of each engine, and is driven at one-half engine speed by gears from the accessory shaft. Each compressor has a capacity of 20 cu. ft. per min. against 100 lb. pressure at an engine speed of 1,500 r.p.m.

The trucks, of cast steel, have 36-in. rolled steel wheels and A.R.A. standard plain journal bearings.

Corrosion.—The Quigley Triple A protective coatings for preventing the corrosion of iron, steel, galvanized and plated surfaces are described in a 24-page booklet issued by the Quigley Furnace Specialties Company, Inc., 26 Cortlandt street, New York. These coatings also waterproof and protect surfaces of concrete, stone, brick, wood, etc.

Report on surface lubrication tests

By P. H. Patton

Lubrication engineer, Sinclair Refining Company, Chicago

An interesting lubrication test was made recently on a western railroad which emphasized in many ways the relation of valve oil lubrication to tonnage-haul. The locomotive on which the tests were run was a 2-10-2 type having 30-in. by 32-in. cylinders. The tests were made under the direction and observation of the lubrication supervisor of the railroad, the road foreman of engines, a representative of the oil company and a number of experts from a university co-operating with the railroad company.

No exact measurement was made on fuel and water consumption, but it was the consensus of opinion of all observers that approximately the same amounts were used on each trip. The engineman lubricated the locomotive to suit himself while making the first trip, but on the remaining trips the feeds were adjusted by one of the observers. A stop watch was used to check the drops fed. The number of drops fed per minute on the first and last trips were as follows:

	First trip	Last trip
Left cylinder	3	1.25
Left valve	1.5	.50
Right valve	4.3	.50
Right cylinder	5.2	1.25
Stoker	1.3	1
Pump	2	1

At no time after the first trip were the valves fed more than one drop and the cylinders more than three drops per minute. Comparing these two trips, there were five minutes difference in both running and total time consumed. The miles were the same. On the first trip 2,169 tons were handled, and 2,413 tons on the last trip, an increase of 244 tons.

The maximum drawbar pull on the first trip was 62,500 lb. and on the last, 70,500 lb., an increase of 8,000 lb. On each trip from the first to the last there was an increase in both drawbar pull and miles run per pint of oil. The outstanding features brought out were the efficiency of the surface lubrication and the relation and result of atomized oil to the steam which carries it.

Some suggestions were made that the free movement of the packing rings was retarded over the surfaces of the walls due to an excessive amount of oil being on the cylinder walls during the first trip. It is not probable that this was the case unless the locomotive had been drifted and thereby causing the oil to oxidize, which makes the walls gummy and sticky. This, no doubt, would cause a retarding effect until after sufficient oil had been fed to soften it again.

When oil is fed to the steam pipes of a locomotive, the oil is picked up by the rushing steam and is supposed to atomize and equalize throughout this great volume. That part of this volume of steam coming in contact with the valve and cylinder walls, and wearing surfaces, is all that performs any work toward lubricating. Therefore, in actual measurement, less than 23 per cent of the oil ever touches the surface, even considering expansion, and the remaining 77 per cent or more goes out with the exhaust after having made no lubrication performance whatever.

Surface lubrication, as obtained by feeding the oil direct to the cylinders, does not give the oil an opportunity to atomize and equalize throughout the great volume of steam rushing in and out, but instead, the oil is thrown out during recession moments. Therefore, it

never goes far from the walls at any time and it quickly settles on the wearing surfaces and is spread by the packing rings.

When the locomotive is not worked at too high a speed, there is one time on each stroke, while the packing rings straddle the port, that the fountain steam pressure in the oil pipe has no back pressure against it and during this instant the oil is freely carried into the open space and the packing rings quickly spread it on the walls. When this oil port is opened to the end of the cylinder under pressure, the oil flow is retarded until a pressure is built up in the oil pipe. But by this time the exhaust is taking place and the recession of pressure permits the oil to flow as the great volume of steam has gone and the oil quickly settles to the surfaces. The small amount of steam left in the exhaust end of the cylinder and with which the oil is atomized, is retarded by compression before it has an opportunity to go to the exhaust port and this gives it further opportunity to perform lubrication work. This last performance is the cause of the good lubrication of pistons on locomotives where the oil is fed to the cylinders. With such performance very little oil is carried away in exhaust steam and it is fair to say that 80 per cent of the oil fed performs lubrication, besides saving energy which under the atomization system is consumed in carrying the oil.

Surface lubrication of valves can be obtained by feeding the oil direct to the valve walls instead of to the steam pipe. The valve oil pipe should be divided at the center point just above the steam chest, the same as the tee of a steam line to double pumps.

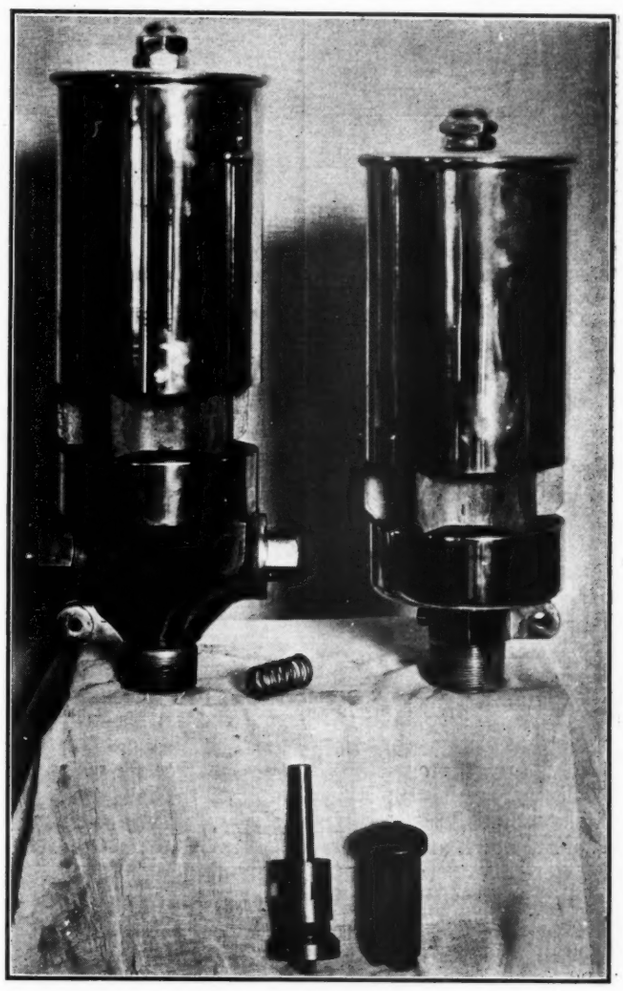
Tap two oil ports through the top of the steam chest to the wearing surfaces of the walls. Locate these ports on their respective ends of the valve chamber so that when the locomotive is working at full stroke the port will be open between the packing rings on the exhaust stroke. Place them near enough to the point where the admission ring travels to its limit so that this ring will block the port just before the exhaust ring opens this space between the two rings to the cylinder port, or have these ports open about ½ in. closer to the cylinder port than at the farthest point at which the outer edge of the admission ring travels on the exhaust stroke.

D. T. & I. adopts standard whistle

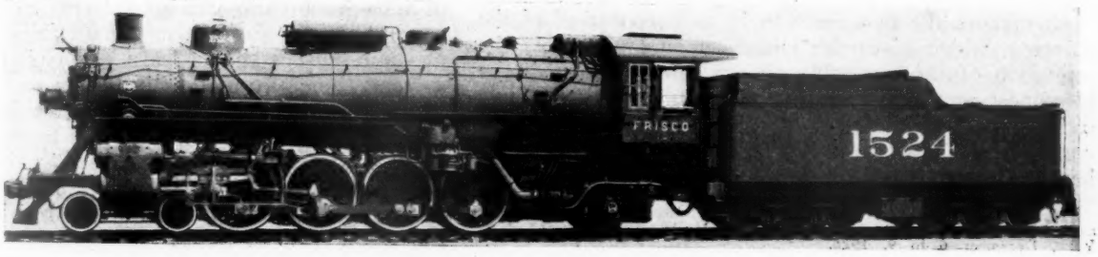
THE Detroit, Toledo & Ironton have adopted as standard for all its locomotives the whistle shown at the left in the illustration. The feature in the design of the new whistle is the spool balance type valve which has proved to give more satisfactory operation than the old type of valve. Both the old and new types of whistle valves are shown in the foreground of the illustration, the new type at the left.

Considerable trouble was experienced with the old valve leaking on account of seating improperly. In addition, the old whistle sounded an unsatisfactory warning signal when the locomotive was approaching a highway crossing.

The new whistle has a greater height than the old design but is of approximately the same diameter. The valve of the standard whistle has a larger steam passage than the old design and the bearing and seating surfaces are finished. The finishing of these surfaces results in a smoother working valve with resultant higher pressure and velocity of the steam as it enters the sounding portion of the whistle.



Left—Locomotive whistle adopted as standard on the D. T. & I. Right—Old style whistle formerly used—The type of valves used in each of these whistles is shown in the foreground



Mountain type locomotive built by the Baldwin Locomotive Works in 1926

The use of wood lacquer finishes*

Preparation of wood surfaces for finishing and methods of applying pyroxylin lacquers that have proved successful in practice

By Walter S. Edgar
Flood & Conklin Co., Newark, N. J.

THE difference between the modern lacquer and that of ten years ago lies largely in the amount of pyroxylin present. Practically all of the principles now being used in the preparation of the lacquer of today have been known for many years. Plasticizers, for instance, which are considered so important in formulating, were discovered about 60 years ago.

Finishing materials fall naturally into three general classes. Class 1 consists of those which dry entirely through chemical changes, and includes such materials as portland cement, plaster, etc. Class 2 consists of those materials which dry by evaporation of the solvent that carries the solid or solids of which the final coating consists. The fundamental difference between classes 1 and 2 is that after those of class 1 have dried they cannot be brought back to their original condition, while those of class 2 may be brought back by the addition of the same solvents which were used in manufacturing them. This second class includes such materials as shellac, shellac substitutes, and wood lacquers. Class 3 consists of the familiar varnishes or oleoresinous compound which might be considered as a combination of the first and second classes. These compounds are made by dissolving fossil resins, or what are more popularly called varnish gums, after they are fused in some type of vegetable oil, to which mixture are added thinners or extenders. With such finishes the first reaction is an evaporation of the solvents, which gives the initial set, and after this the oxidation of the vegetable oils, which oils furnish the toughness and durability to the finished coating. This oxidation changes entirely the character of the oil, and consequently of the coating, and it cannot be brought back to its original condition.

*Abstract of paper presented by the Wood Industries Division at the annual meeting of the American Society of Mechanical Engineers, New York, December 6 to 9, 1926.

Pyroxylin as a binder

All wood-finishing materials are built around some type of binder which should be hard, elastic, and durable. In the lacquer type of finishing materials the binder is known as pyroxylin or nitrated cotton. This is a stable chemical compound and as such is a better binder than a drying oil, which through oxidation changes progressively, and where the oxidation is made too rapidly because of the method of manufacture, the finish is injured by the "burning" of the oil. The particular point to bear in mind is that as soon as the solvents have evaporated from a lacquer, leaving on the surface a pyroxylin binder, a permanent, hard, elastic finish is produced which undergoes no chemical change causing deterioration. On the other hand, an oleoresinous finish is subject to progressive change and deterioration through oxidation.

Pyroxylin is made by treating linters, which are the short fibers of cotton closest to the seed, with a mixture of acids, principally nitric. The average amount of nitration is 12 per cent, and it is vitally important to control this to the fraction of a per cent to obtain uniform results in the various types of lacquers. After these cotton linters have been so treated they become soluble. in a large number of solvents, and the degree of solubility of nitrocellulose in various solvents and under various conditions is one of the important things that the users of these finishes should learn. Fortunately none of the solvents generally used is injurious to health. This nitrated cotton is white and somewhat fluffy. Sometimes it may have been noticed that the lacquer has whitened when drying. This effect is caused by the actual precipitation of the cotton in the lacquer, brought about by the presence of too much of a liquid which is not a solvent for cotton, such as water.

Various ingredients are added to the binder for the properties which they possess: gums for adhesion, gloss, and ease of rubbing and to increase the solid content; pigment for color effect. As in varnish, the apparent consistency of the material is no real indication of the total amount of solids present. Two solutions of the same viscosity may vary from 10 to 15 per cent in solids, due to the difference in the binder or the different way in which the binder is thinned.

Preparation of the wood surface for finishing

Starting with the glues, we may note what may happen with the various types and the effect they may have on the lacquer coating. There are two general classes of glue now in common use: namely, vegetable glue and animal glue. A vegetable glue is somewhat cheaper, can be more easily handled by skilled help, and does not dry as quickly as animal glue. If a vegetable glue is used with lacquer some care should be taken to note that it is entirely dry before the first coat of lacquer is applied, and that an excessive amount of caustic has not been used in its preparation. This caustic would retain the water and act on the nitro-cotton, producing a white cast. Under these circumstances the writer would recommend the use of animal glue.

After the veneer has been prepared, extra care should be used in the sanding. Lacquer does not fill as well as varnish because of its speed of drying, therefore the amount of extra labor spent on the preparation of the surface is well repaid by the results obtained and material saved.

Staining—The wood is now ready for staining. Water stains should be used as they are less soluble in the solvents used in lacquer than are either spirit or oil stains, and there is less probability of their coming to the surface where the action of the sun's rays will bleach or discolor them.

After the wood has been stained it should be allowed to dry at least 24 hours before commencing the filing operation.

Filling—It is now generally conceded that the best and cheapest practice is to give the wood a wash coat of either shellac or lacquer, followed by a light sanding before filling. This method not only gives a better and smoother foundation for succeeding coats, but prevents the binder in the filler from being absorbed by any spongy or soft veneer and also prevents the filler from turning gray or white. It generally saves a coat of varnish or lacquer and prevents not only trouble with the filler, but shrinkage of the finish as well.

Reasons why fillers bleach

One of the great cries against lacquer is that it bleaches the filler. This is never so under reasonably fair conditions. Bleaching the filler is due to one of three causes.

First, the filler may be applied in a very dry condition, and if it is not packed into the pores of the wood there is an initial swelling when the lacquer is applied. In a short time this settles down, pulling the lacquer away from each pore, which by light refraction shows "white." The remedy is obvious: all filler should be applied in as heavy a condition as possible and rubbed in, and on work which is to be of extra quality a double filling operation should be made.

Second, another cause of bleaching may be the fact that soluble colors were used in the preparation of the filler. As the lacquer is applied the solvents dissolve these oil colors and bring them to the top, leaving nothing but the oil and silex, which naturally produces a gray cast.

Third, still another cause may be the use of too much turpentine substitutes and naphtha. This material staying in the filler attacks the under side of the lacquer, and again we have the well-known condition of precipitation, producing a grayish cast.

Generally speaking, the filler that is used should not be too short and should not dry with a gray cast. If such a filler is being used the conditions may be corrected by the addition of oil and japan drier, turpentine being used as a thinning agent.

Spraying—Blooming troubles

After the filler has dried for at least 48 hours and has been rubbed and sanded, care being taken that there is no smear on the work, it is then ready for the spraying. The first trouble from spraying is entrapped air and the remedy for this is quite obvious. Either the lacquer should be thinned or the air pressure should be raised so that the lacquer may be better atomized. An extreme condition of this type will result in the lacquer going on too dry, causing so-called "spray dust" and the same remedy should be taken. Bridging over moldings, etc., also results from substantially the same condition.

Lacquers during very humid weather sometimes show a bloom. What happens when a lacquer blooms may be readily understood by remembering the process for the manufacture of artificial ice. Wherever we have a liquid which is expanding to a gas, a large amount of heat is taken up from the surrounding atmosphere, the temperature is naturally lowered, the dewpoint is reached, water is deposited on the lacquer surface, remains there after the solvents have evaporated and again we have our familiar white appearance due to the throwing out of the cotton by the non-solvent. Two remedies may be used to overcome this condition. First, the lacquer may be made slow-drying enough to bring the rate of evaporation to that point where the temperature is not severely affected or in the event that water does enter into the lacquer film, it will pass off before all of the solvents evaporate. These slow-drying solvents, unfortunately, are the most expensive ones, and it is more economical for a consumer to carry in stock a material usually called a "retarder." This may be added to the lacquer on those days when the relative humidity is high, and when this blooming trouble might be expected to appear. Second, certain very simple chemical means may be taken to help this condition. A number of lacquer consumers are now placing shallow pans containing calcium chloride in their spray rooms. It is also oftentimes helpful to heat the air, which naturally reduces the humidity.

Rubbing and patching

After the lacquer has been sprayed and dried, it is ready for the rubbing and patching. The time which should elapse between successive coats of lacquer depends largely on the type of lacquer and the kind of work being finished. Usually the best results are obtained by applying only one coat of lacquer each day and rubbing after 24 hours. This method helps to prevent shrinkage.

Generally speaking, it is possible to spray coats of the average type of lacquer about four to eight hours apart. Some lacquers give the best condition for rubbing after having stood for about 40 hours. Others should be rubbed after standing over night. It will need some experimenting under the conditions in each particular plant, as well as the recommendation of the man who is offering the material to determine the best schedule for coating and rubbing. Most furniture manufacturers prefer

an oil for rubbing, since it saves one operation. The writer prefers water, or if this is not possible, then a debloomed oil.

The grayish cast which comes on the lacquer surface after it has been oil-rubbed may come from two causes: First, the lacquer may have been rubbed too quickly or too severely, and some of the pumice which was used may have been ground into the surface; then, as the rubbing vehicle dries out the pumice comes back to its original color, producing a grayish, spotty cast over the surface of the work. To overcome this condition, a fine pumice should be used, allowing the work to dry for two days before rubbing. Second, the grayish cast may also be due to the neglect of the finisher to thoroughly clean off the oil from the surface. This oil penetrates the lacquer finish and since oil is not a solvent for pyroxylin, it precipitates the cotton and produces our familiar gray.

Those places which have been rubbed through should not be touched up with alcohol or shellac, as would usually be done with varnish, but a lacquer toner should be prepared. This is made in the same manner and applied in the same way as colored shellac.

Tendency to rush lacquer too fast

It will be noted throughout the entire consideration of lacquer, that this relation of solvent to pyroxylin stands out as the one thing to be remembered. Lacquer has been so widely advertised as a quick finish that there is a grave possibility it will be abused in this respect and that there will be a tendency to rush it too fast.

If it were possible to secure the adhesion, filling, and easy rubbing that is necessary to produce a satisfactory finish on wood with pure nitrocellulose, the finish would be practically indestructible. While lacquer gives a particularly tough and hard finish, it does not compare favorably with the oil products as far as distensibility is concerned. A pure nitrocellulose film of the usual commercial low-viscosity type, suitable for use in a wood lacquer, has comparatively little flexibility, and it has been found necessary to add extremely slow-drying solvents known as plasticizers so that the solution theoretically will never dry. This tends to add materially to its distensibility. One of the characteristics of nitrocellulose is its failure in a clear film under sunlight exposure. Among the investigations which have been made is that of the absorption of the ultra-violet light by nitrocellulose and vegetable-oil films, in which it is clearly shown that nitrocellulose films do not absorb as large an amount as the vegetable-oil, but that the effect of the smaller amount of rays absorbed is greater on the nitrocellulose film than on the vegetable-oil film. Furthermore the structure of nitrocellulose has been likened to an inverted pyramid, in which the slightest change on the point produces a rapid and cumulative deterioration. The problem in this case would seem to be one of finding a suitable stabilizer which would prevent this first reaction. Most of the stabilizers now used for that purpose either have an objectionable color or are not active enough to accomplish results desired.

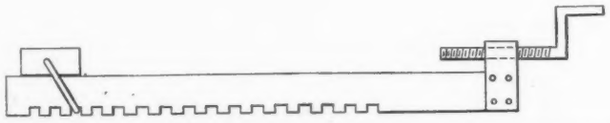
When automobile lacquer enamels were first prepared very little thought was given to the selection of the pigment. Generally the pigment which gave the color desired was selected with oftentimes very disastrous results. At the present time it is quite generally known what pigments should be used with lacquer coating to secure the most satisfactory results. The question which comes to most minds in considering the relation of the binder to the coating material, is why any number of hard, durable materials cannot be used for coating. There are a great number of compounds which are known to be durable and to give a satisfactory appearance, and it would naturally seem that they should be commercially practical. Almost without exception, however, these have the disadvantage of not drying quickly from solution. If we could produce a material which dried by a combination of chemical changes and evaporation, one in which we could control the rate of chemical change, we should be approximately at the point of having an ideal coating material. Such a material should produce a glossy, good-filling and adhesive material, which when sprayed upon the work would so change that succeeding coats would not attack it. It would be a material which would be practically 100 per cent film, reducing the cost materially.

Considering the plans which the formulator of coating material has in mind, the possibilities of using a long range of materials, there can be no doubt that the problem will be more quickly solved if there is the closest co-operation between the man who is manufacturing the material and the man who is to apply it. The history of the modern lacquer industry shows very clearly that more than half of the problems in their use are connected very closely with methods of application. Much of the success in the automotive field is undoubtedly due to the desire on the part of the lacquer man to meet the conditions which have been laid out for him rather than to attempt to make the conditions meet his formulating. Certainly, unless there is a broad understanding between the manufacturer and the consumer, with a good understanding on the part of the man who is directly concerned with the application, there can be no progress, but such co-operation, when it comes about, as no doubt it will in the near future, will unquestionably result in the development of the ideal coating material.

A handy clamp for the woodworker

By Joseph C. Coyle

WHEN doing fine wood work there is always need for a good clamp that will hold two pieces of wood firmly together without marring the finish. The clamp shown in the sketch is used in the coach shops of the Denver & Rio Grande Western, Denver, Col. It is made of a section of tough hard wood, 4 ft. long, 1½ in. thick and 6 in. wide. Notches are cut in one edge, as shown in the sketch, into which fits a clevis holding a buffer



Sketch of a shop-made clamp which can be used for many clamping jobs in a cabinet shop

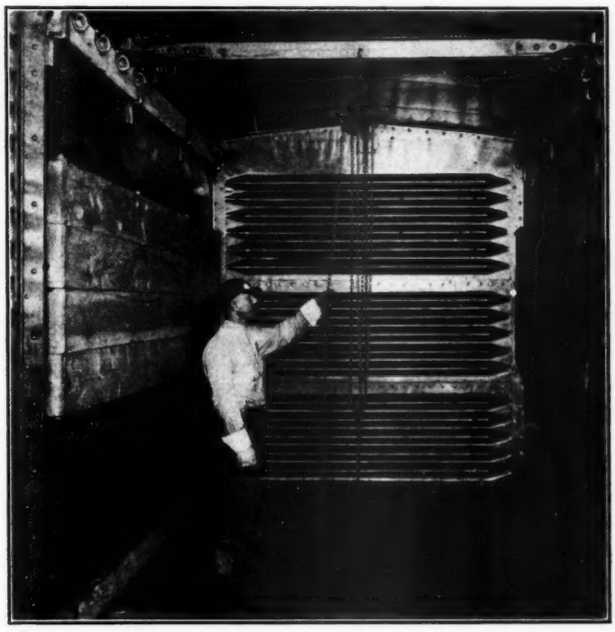
block of the same kind of wood. This can be adjusted from notch to notch. The long section is mortised at the opposite end into a second short block, in the end of which is secured a screw plate to receive a threaded crank shaft for tightening the clamp. A square block of wood, or several blocks can be inserted between the end of the crank and the pieces to he held in place if necessary to protect the work.

Automobile cars fitted with traveling cranes

TO accommodate a constantly increasing freight traffic in automobiles, the Union Pacific has placed in service 1,000 new steel automobile cars, the feature of which is a 3,000-lb. capacity traveling crane in each car to facilitate loading and unloading. Seven hundred of these cars were received from the General American Car Company, and 300 from the Pennsylvania Car Company. They are 50-ft., all-steel cars, with 12-ft. corrugated steel side doors. The traveling crane in each car operates on runways extending the entire length of the car, enabling the crane with attached chain block, furnished by the shipper, to be placed at any desired point in the car, and moved to any point of the car while under load. Eye-bolts in the center of each end of the car and near the roof are also provided for attaching a chain block or ropes when necessary. When not in use, the traveling crane can be locked against either end of the car or at intermediate points by means of chains and eye-brackets; the latter are clearly shown in the interior photograph.

So many automobiles of the sedan type are being shipped at the present time that the tilting method of loading is largely used, and the traveling crane in the new Union Pacific automobile cars will save considerable time and labor in lifting the front ends and moving automobiles to the proper position for the application of especially-prepared braces and blocks. The crane will be particularly valuable in unloading cars at outlying points where facilities for handling automobiles are not nearly as adequate as at the manufacturer's shipping department. At unloading points not properly equipped, car roofs are frequently damaged by makeshift methods of attaching ropes or chain blocks and attempting to raise weights for which the roofs are not designed. The provision of traveling cranes in these cars will remove all necessity or excuse for the use of such methods in unloading automobiles and thus prevent considerable car damage.

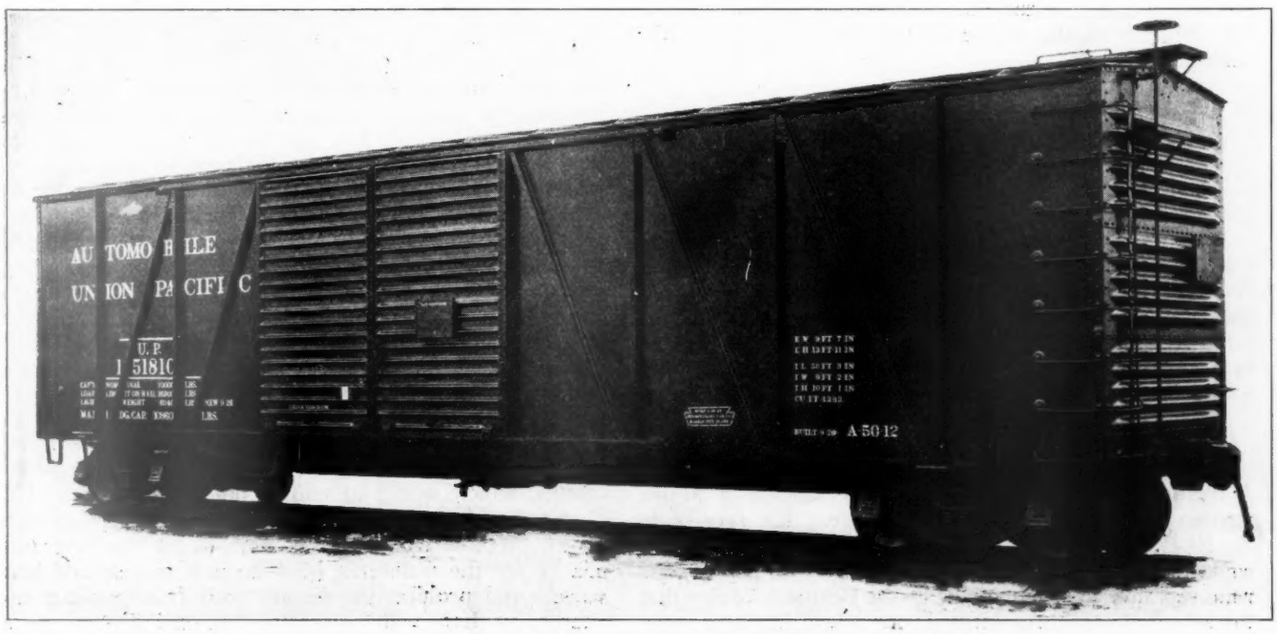
The cars are unlined except for three sets of belt rails,



The 3000-lb. traveling crane carriage with a chain hoist attached

one at the floor level 6 in. wide, one extending from 3 ft. 6 in. to 7 ft. 4 in. above the floor, and the third at the top of the car, 6¾ in. wide.

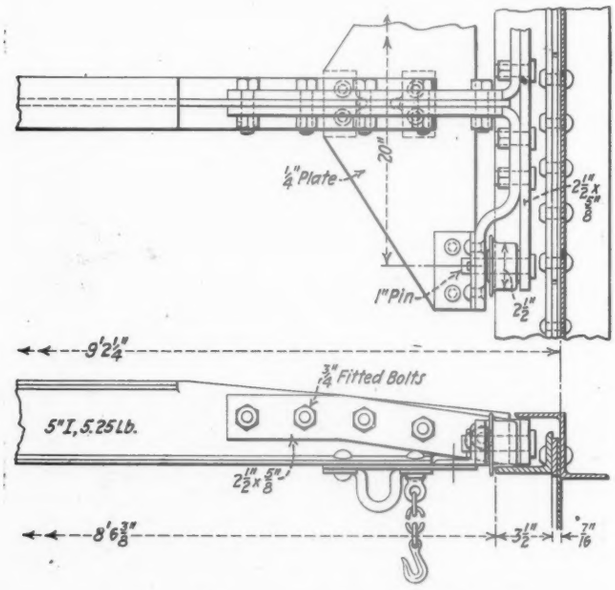
A still further advantage of the traveling crane is that



One of 1000 new Union Pacific automobile cars, each equipped with a 3000-lb. traveling crane

it can be used for the shipment of heavy machinery in units up to 3,000 lb. in weight with a great saving in time and effort in handling. In one case, gasoline engines were shipped using the double deck method of loading, in which the traveling crane proved a highly effective aid.

The span of the traveling crane used in these cars is 8 ft. 6⅜ in. The steel tracks are built up of structural shapes in such a way as to prevent any possibility of derailment. The crane carriages are made of forged steel, so designed that the rollers are 20 in. apart on



Traveling crane and track details

centers. The rollers, 2½ in. in diameter with flanges 7/16 in. high, revolve on 1-in. open hearth steel pins fitted in reamed holes. The safety chains, made of ⅜ in. stock, are used in connection with the two chain eyes and eye-brackets under the tracks to lock the crane in any desired position. The crane is substantial in all its details so that it can safely carry a load of 3,000 lb. Stops on each end of the tracks prevent possible damage to the car ends by over-running of the crane.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Brake burned wheels car owners' responsibility

Included in a bill rendered by the Boston & Maine against the American Railway Express for repairs to A. R. E. car No. 350, was a charge for removing and replacing two pairs of wheels—one pair of which was removed due to a claim made by the Boston & Maine that the wheels were brake burned; one wheel having a worn flange, the wheel report showing that 2/16 in. loss of service metal should be charged to the worn flange and a loss of 3/16 in. service metal to brake burn. The car owner took exception to the charge on this pair of wheels, claiming that the defect on the two wheels shown as "brake burn" on the wheel card representing what would be termed slid-flat spots which under A. R. A. rules would represent operating or delivering line responsibility; the labor for exchanging, turning of wheels and any other charge in connection with the removing and replacing of the wheels, as well as the loss of service metal, would also represent operating or delivering line responsibility. The Boston & Maine stated that the wheels which were removed because of brake burn were also found to have worn flanges but could not be condemned for this reason and would not have been removed except because of the combined defects. It was further stated that it was necessary to remove 5/16 in. of service metal, which removed the brake burn, to restore the full flange contour. An inspection made by competent employees of the railroad company led to the conclusion that the wheels were defective because of brake burn of a nature conforming in every detail to passenger car Rule 17 paragraph 3.

The Arbitration Committee in handing down its decision stated that the car owner is responsible in accordance with the provisions of Rule 7 Section (f) of the Passenger Code—*Case No.* 1432 *American Railway Express vs Boston & Maine.*

New wheels removed by another road within 30 days

On November 7, 1924, the Chicago, Milwaukee & St. Paul changed four pairs of wheels on the Union Oil Company's car No. 627 because of slid-flat spots four inches long, charging the car owner the difference between new and second hand wheels. Nineteen days later it was necessary for the Northern Pacific to replace two of these wheels because of slid-flat spots three inches long, for which a charge was made amounting to the difference between new and second hand wheels. The reason for changing wheels in both instances was slid-flat spots, which is a handling line's responsibility. The car owner contended, in view of Arbitration Decisions No. 1371 and 1372 and in view of the fact that the damage to the wheels was wholly railroad responsibility and that the wheels applied by the Chicago, Milwaukee & St. Paul had run only nineteen days, that the arbitration decisions mentioned should be made to apply on cars regardless of whether the mishandling happened on the same road or not. The car owner further contended that it should receive credit for new wheels when the wheels in question had run only 19 days and approximately 80 miles. The Northern Pacific in its statement considered the charge correct for the following reasons: (1.) Arbitration Decision 1371 clearly limits its application to cases in which wheels are changed on the same road within 30 days' time. (2.) In view of the provision in Paragraph (b) of Rule 98, if the contention of the Union Oil Company were allowed, it would be impracticable for a repairing line to tell whether or not the wheels were applied by an intermediate road within the 30-day limit, and the only way in which it could protect itself from loss would be by applying second-hand wheels, which would of course not be desirable. (3.) One railroad should not be penalized for what occurred on another; it would not be fair to let the first road charge for the difference between new and second hand wheels and prohibit the second road from making any charge, as there would be equal responsibility so far as damaging the wheels is concerned.

The Arbitration Committee in rendering its decision, sustained the contention of the Northern Pacific, in view of Rule 98, Section (b).—*Case No.* 1435, *Union Oil Company vs Northern Pacific.*

Wheels and journal bearings applied at short intervals

On April 1, 1924, the Chicago & Eastern Illinois changed wheels at location R. & L. 1 under D. A. C. X. tank Car No. 1514 because of a sharp flange on one wheel, the mate wheel being a good second-hand wheel. One pair of new wheels and two new nine-inch solid journal bearings were applied. On April 2, 1924, the Louisville & Nashville applied one new nine-inch solid journal bearing at location R. 1 on account of being worn out. On April 9, 1924, the Atlantic Coast Line applied one pair of new wheels at location R. & L. 1 removing one wheel with a seamy tread, the other being a good second-hand wheel, and applied two new nine-inch solid journal bearings. Darling & Company, the car owners, took exception to the charges rendered against them for the new journal bearing applied by the Louisville & Nashville, also to the charge rendered by the Chicago & Eastern Illinois, requesting rebate on account of the failure of the new wheels applied by them. The contention of the car owner was that it were entitled to a rebate on account of the failure of the new wheel to give service under the guarantee of the wheel makers. In the statement made by the car owner, it was shown that the journal brass applied by the L. & N. had been renewed after a car movement of only 52 miles and exception to the charge made was based on the contention that, given a journal in good condition, likewise a brass in good condition, it would not have been necessary to replace the brass after 52 miles of travel on account of wear.

The Arbitration Committee did not sustain objections of the car owner and in its decision said, "With reference to the pair of wheels removed by the Atlantic Coast Line on account of a seam, there is no evidence that this defect was apparent at the time of application of the new wheels by the Chicago & Eastern Illinois. With regard to the charge for the journal bearing renewed by the Louisville & Nashville, Rule 99 is definitely confined to the second or subsequent renewal on the same road." —*Case No. 1436—Atlantic Coast Line, Chicago & Eastern Illinois and Louisville & Nashville vs. Darling & Company.*

Application of new cast iron wheels in place of wrought-steel

On November 7, 1923, the Pere Marquette applied one pair of new cast-iron wheels under Chesapeake & Ohio car No. 56184 in place of wrought-steel wheels removed, which were standard to the car. This work was done on authority of Big Four defect card covering a cut journal. The Pere Marquette billed the Chesapeake & Ohio for one pair of cast-iron wheels and allowed the C. & O. credit for the amount of service metal on the forged steel wheels at the time they were removed. The Chesapeake & Ohio took exception to the charges, contending that the Big Four defect card was authority to remove and replace the wheels and true up the journal, or to remove the wheels and apply other wrought-steel wheels, and as neither the C. & O. or the Big Four had control over the Pere Marquette in making repairs to this car, the charge for the wheels applied should be confined to the second-hand value of cast-iron wheels. The Pere Marquette contended that the charge for new cast-iron wheels was correct and that the C. & O. should have rendered a bill against the Big Four on authority of the defect card for the difference in value of new and second-hand cast iron wheels. The C. & O. further contended that the Big Four could not be held responsible for such a charge and in accordance with Rule 98, effective January 1, 1924, the C. & O. should not have been charged for new cast-iron wheels in this case.

The Arbitration Committee, in rendering its decision, did not sustain the contention of the Pere Marquette and stated that "Their charge for new cast-iron wheels should be confined to second-hand value, per Interpretation No. 4 to Rule 98."—*Case No. 1437—Chesapeake & Ohio vs. Pere Marquette.*

Car owner responsible in case of wheels applied on same road within 30 days

On January 23, 1925, the Chicago, Burlington & Quincy applied two pairs of new wheels to Denver & Salt Lake car No. 34250, in positions R. & L. 3 and 4 on account of being slid-flat and one journal worn to 10 1-2 in., at the same time cleaning the air brakes on this car and applying new 10-in. Wabco cylinder piston packing. On January 24, 1925, after this car had been moved 110 miles, the C. B. & Q. changed four pairs of wheels on account of two cracked plates, R. & L. 1, brake burned R. 2, cracked plate L. 2, cracked tread R. 3, cracked plate R. 4. Wheels L. 3 and L. 4 were shown as O.K. The air brakes were again cleaned, the report having shown them to be inoperative, causing hot wheels. The triple valve tested O.K. on the test rack. The 10-in. cylinder piston follower was found broken. The Denver & Salt Lake took exception to the charges made and requested the C. B. & Q. to investigate the claim of owners' defect on the second application of four pairs of wheels of which six were defective, it being the contention that the wheel charge against the car owner was not proper. The C. B. & Q. replied that an investigation failed to reveal any cause of wheel defects, the triple valves having performed satisfactory under test and the air brakes being inoperative because of a broken cylinder piston follower. Comment was made of the fact that such a defect as last mentioned would have a tendency to cause brakes to leak off rather than to hold and cause hot wheels.

The Arbitration Committee in rendering its decision stated that the car owner is responsible in this case in accordance with Rule 71 and 78. However, in view of the second application of wheels at R. & L. 3 and 4 on the same road within the 30-day limit, the initial charge for the difference in value between new and second-hand wheels should be withdrawn in accordance with Interpretation No. 11 to Rule 98. *Case No. 1438—Denver & Salt Lake vs. Chicago, Burlington & Quincy.* Car-Arbitration Decisions- Ry Mech Eng-Wilcox

Responsibility for damaged car involved in derailment

Under date of February 24, 1925, the Central Railroad of New Jersey notified the Maine Central that M. C. car No. 8493 had broken in two in a train when making a stop to set off cars. Following the damage to the car, it derailed, not causing the accident but resulting from it. The Jersey Central reported the car to the owners for disposition under Rule 120. Joint inspection certificate did not accompany the notice at the time but was sent later. Because of the fact that the car was de-

railed after it had been damaged, the car owners refused to authorize the repairs, claiming that the handling line was responsible on account of the derailment. The Maine Central refused to authorize the repairs because inspection certificate did not accompany the notice of accident, and no mention was made of the derailment at the time of the accident. The car owners claim that as the derailment occurred in this accident the handling line should be responsible under Rule 32 and that this case should be handled under Rule 112.

The decision of the Arbitration Committee was to the effect that as the car was derailed, the handling line is responsible and the decision rendered in Arbitration Case No. 1179 applies in this case.—*Case No. 1439—Central Railroad of New Jersey vs. Maine Central.*

Absence of stencil after extended period not conclusive evidence of failure to mark properly

The Charleston & Western Carolina charged the Cincinnati, Indianapolis & Western $4.35 for cleaning oiling, testing and stenciling the cylinder and triple valve on C. I. & W. car 25022. The Buffalo, Rochester & Pittsburgh charged the C. I. & W. $4.35 for doing the same work on the same car about nine months later—claiming that the car showed no stenciling as to date or place previously cleaned. The C. I. & W. on receipt of the repair card of the B. R. & P. made a claim against the C. & W. C. stating that they had failed to stencil the car as provided in Rule No. 60 as evidenced by the B. R. & P. billing repair card and asked that charges for repairs be cancelled. The C. & W. C. refused to cancel their charges, claiming that in accordance with Interpretation No. 5 of Rule 60 the car owner should assume the charge as it was impossible to determine responsibility. During the nine months in question, attention was called to the fact that this car was interchanged between foreign lines 15 times and from foreign lines to the owner and from the owner to foreign lines 12 times and that it was on the owner's line 51 days during this period. Neither the car owner nor any of the foreign lines noted an exception that the car was not properly stenciled. The C. & W. C. in its statement contended that there was a serious doubt as to the accuracy of the B. R. & P. repair card and therefore the car owner has no claim against the C. & W. C. It further contended that the B. R. & P. was not an intermediate line as the car was interchanged 12 times between the dates the brakes were cleaned by the C. & W. C. and the B. R. & P. which disallows the use of the B. R. & P. repair card against the C. & W. C. as a joint evidence under Rule 90.

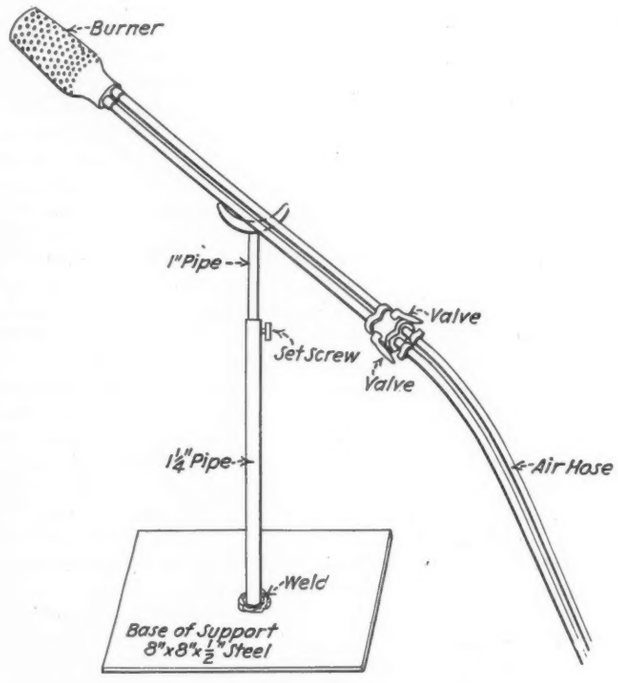
The Arbitration Committee in rendering its decision made note of the fact that the car had been continued in service nine months without exception to the cleaning marks. It further commented on the fact that there is no conclusive evidence that the cleaning marks were omitted when the brakes were cleaned. Therefore, the repairing line is entitled to the benefit of the doubt in accordance with Interpretation No. 5 to Rule 60 and the bill of the Charleston & Western Carolina is sustained.—*Case No. 1441—Charleston & Western Carolina vs. Cincinnati, Indianapolis & Western.*

DROP FORGED TOOLS.—Wrenches of all types, eye-bolts, chisels, clamps, dogs, ends, extensions, hammers, tool kits, nuts, pliers, punches, ratchets, screw-drivers, thumb screws, sets, sleeves, sockets, cotter pin tools, drop forgings, etc., are covered in the combined hand-book and catalogue of the Billings & Spencer Company, Hartford, Conn. This catalogue contains 122 pages and in size is 7 in. by 5½ in.

Convenient torch rest for the steel worker

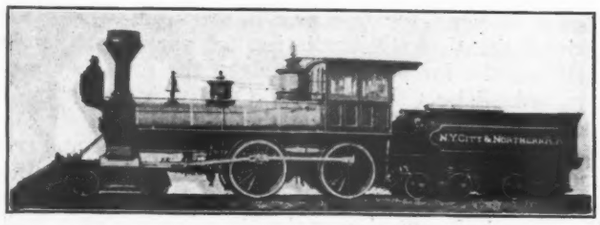
By Joseph C. Coyle

SOME parts of steel cars, that must be straightened, require a long time to heat and the blow torch becomes a burden to the workman unless a suitable support for the torch is at hand. The steel workers at the Burnham shops of the Denver & Rio Grande Western, Denver, Col., as using a home-made torch rest that is satisfactory. It is made by welding a two-foot section



Sketch of torch rest used in the steel car shops of the D. & R. G. W.

of 1¼-in. iron pipe on an 8-in. by 8-in. base of ½-in sheet metal. A second section of one-inch pipe fits inside the first and is held in place by a set screw in the outer section after the height has been set satisfactorily. A half moon-shaped piece of steel about three inches long is welded to the top, as shown in the sketch. This support is light and can easily be moved from place to place by the workman. The torch can be held in place without any effort on the part of the operator by forcing the half moon between the torch feed pipes.



New York City & Northern 4-4-0 type locomotive built in 1879—17-in. by 24-in. cylinders and 60½-in driving wheels

Yard inspection of freight cars*

Specialized forces for terminal inspection and repairs, adapted from progressive repair methods, are advocated

By A. J. Krueger

Master car builder, N. Y. C. & St. L.

FREIGHT car inspection in its relation to freight train operation is one of the most important and difficult problems confronting the railroads today. The successful operation of freight trains fundamentally depends upon the ability of the railroad to obtain a proper freight car inspection and in this manner move trains with full capacity tonnage from one terminal to another without interruption on account of equipment failures. In order to accomplish this, it requires positive freight car inspection, as well as maintaining such inspection at all times.

Ordinarily, there are two ways in which inspection can be performed. One is termed Positive, the other, Negative. Positive inspection can be secured by means of a well organized force of inspectors, properly instructed and supervised and regularly assigned to perform certain duties and in this manner specialize in their work and know, beyond the question of a doubt, that every part of the car body and trucks has been properly inspected. Negative inspection is secured by making inspection in a general way without any well defined system set up covering the duties to be performed by each inspector and which condition can easily be found in a great many railroad yards today. When we analyze this situation, we cannot be surprised at the failures which occur considering the short period of time in which the inspector is required to perform his work. Positive inspection cannot be accomplished unless we give consideration to some of the things which are essential to make it successful.

In making inspection of a freight car under common present day methods, the inspector is usually required to observe the condition of all parts on car body and trucks (except possibly the air brakes and journal boxes) in a very short period of time. Inspections made in this manner make it necessary for each inspector to detect, among other things, the following:

Loose and missing box and column bolt nuts.

Condition of journal boxes, truck springs, spring planks, truck bolsters, arch bars, or side frames.

Condition of brake rigging, which is intended to mean that the inspector should observe the condition of brake beams and hangers, brake beam truss rods and nuts, fulcrums, compression and tension members, brake heads, brake shoes and keys, bottom connections, brake levers, and most important of all to know that all brake and brake hanger pins have cotters properly spread and in good condition, or a suitable device for holding the pins in place.

Condition of wheels by inspecting for cracked plates, broken rims, loose wheels and other condemnable wheel defects.

Condition of safety appliances, couplers and parts, draft gear and parts, etc.

Condition of car body including underframe, ends, sides and doors, roof and running boards.

These are some of the things we expect our freight car inspectors to do and when we devote the proper attention to the possibility of accomplishing this, it seems that this kind of inspection can better be accomplished by specializing or classifying the work; in other words, to assign definitely to certain men the inspection of certain parts of the car body and trucks.

*Abstract of a paper presented before the Cleveland Steam Railway Club, November 1, 1926.

Specialized inspection already partially in effect

The progressive car repair shops of today are operating on this basis and some progress in freight car inspection has been made along these lines, as invariably the air brake inspection and inspection of journal boxes and contained parts is made in this manner at most railroad terminals at the present time. There appears to be no reason, therefore, why this policy could not be successfully extended, and as an example, could be operated somewhat in the following manner:

A—Car oilers assigned to lifting journal box lids, making careful examination of journal bearings, journal bearing wedges, Journal box packing, making repairs where required and making sure there is no evidence of heating or trouble on account of hot boxes.

B—Inspectors assigned to air brake inspection and repairs.

C—Inspectors assigned to trucks, including all truck parts, brake rigging and wheel inspection and repairs.

D—Inspectors assigned to couplers and parts, draft gears and safety appliance inspection and repairs.

E—Inspectors assigned to general condition of car body, side doors and roof inspection and repairs.

This plan can, of course, be modified to suit local conditions as they exist and when we consider that the more efficient our freight car inspection and repairs become in our train yards, it should reflect a decrease in the number of cars condemned to the repair tracks.

Specializing or classifying car inspection requires analysis on the part of our supervision to select men particularly suited to the individual requirements of the assigned position. It has been found that men were selected for inspectors from repair track forces at random and sent out to inspect trains without the supervisor spending enough time to instruct them properly for this work, which results in men being out in the train yards as inspectors who really "don't know where they are going, but are on their way."

Essential to positive freight car inspection is the manner in which interchange inspection is performed. Ordinarily, we think of interchange inspection made at some outlying inspection point where the inspector usually has sufficient time to go over the cars three or four times if necessary and at such location there should not be much occasion for failure to secure proper inspection and repairs. However, interchange inspection as performed at large originating terminals presents no easy problem to solve. We all, no doubt, have pulled trains coming from connections or industries which are delivered at four or five different locations, making it necessary either to establish separate inspection forces, or require inspectors to go from one location to another, which consumes considerable time. This, therefore, among other things, suggests that considerable improvement in inspection and conservation of time should be secured if arrangements are made to concentrate car

inspection at designated locations with a force sufficient to specialize on the inspection and make repairs at the same time.

How the transportation department can co-operate

In order to do this, close co-operation is required between the transportation and mechanical departments, so that the proper tracks can be selected and assigned for this purpose to make it possible for the mechanical department to function properly in this respect consistent with the facilities available.

Adequate material supply for inspectors and train yard repairmen, as well as an effective means of transporting such material, is in most cases such that it actually makes it a burden for the inspector to make the necessary repairs in the train yard. It is no uncommon sight to see an inspector crawl in between cars and walk a considerable distance to secure a knuckle or lock or other items to make a repair and the greater the hardship we work upon the inspector to do this, the greater the liability for the inspector to take a chance and permit the defective part to continue in service.

Important to freight car inspection is the manner in which equipment failures are investigated. Usually such investigations are made by the local supervisor in charge in the territory where such failures occur. Very often, in making such investigations, we find occasion to criticise the inspector for failure to observe the defective condition of the part which caused trouble, with out deciding if the inspector has been properly instructed, if he is competent to perform the work required of him and if he has sufficient time to make positive inspection. I am inclined to think that we are too ready to jump all over the inspector for his shortcomings, in place of deciding what can be done to help him.

Considerable improvement could be brought about by creating a desire on the part of the inspector to feel free to make recommendations, or suggestions, to his foreman in connection with his work. This can be accomplished by making the inspector feel that he is an important and necessary part of the organization created by means of close frequent contact on the part of the local supervisor and will result as well in the supervisor becoming intimate with the peculiar problems and difficulties that the inspector is up against. It is certainly worth while to hold meetings with our inspectors at regular stated intervals so that he will become accustomed to looking forward to such a meeting for the free discussion of problems, current instructions issued and the effective A.R.A. rules of interchange which apply to his work.

We often find that certain instructions which have been issued are not being followed and upon looking into this we discover that there has been no method established for providing the inspectors with such instructions.

The kind of tools and gages which are supplied to inspectors for their work is of the utmost importance and also that he knows how to use them. Take for example the use of the A.R.A. wheel and coupler gage: How often do any of us make it a point to find out if the inspector really knows how to use it and if we know all about it ourselves?

How the transportation department will be benefitted

On the other hand the character of the repairs made to cars on repair tracks can be of material assistance to the inspector in his work by turning out repaired equipment which will operate in service without causing failure.

This review on freight car inspection is principally confined to the more important items which it is felt will produce positive inspection and in which specialized inspection is advocated. The results which can be obtained by proper freight car inspection with respect to train operation can, among other things, be measured by means of the following:

1—Decrease in average time of trains between terminals.
2—Decrease in number of cars set out, or causing delays to trains on account of defective equipment, which permits increase in tonnage.
3—Decrease in number of lb. of coal consumed per thousand gross ton miles.
4—Increase in percentage of fast freight trains making assigned schedules.
5—Increase in freight car miles per hot box.

Railroad revenue is derived exclusively through its transportation service to the public, which cannot be obtained without making it possible to operate freight trains quickly and safely and which, among other things, depends largely upon the various types of inspection of freight cars as follows:

First—The inspection made of the empty car to determine its fitness to carry the load intended.
Second—The interchange inspection and repairs made at the originating point on each line.
Third—The terminal inspection and repairs made while the car is en route.

There are so many things indirectly concerned with the accomplishment of proper freight car inspection, that it requires continual study and analysis.

The manner in which we are today performing freight car inspection at large terminals has made very little progress as compared with the way in which it was done since railroads were first operated.

In visualizing the improvements which can be made to secure the highest standard of freight car inspection, it is not hard to realize that the future will develop a method for inspection upon the arrival of freight trains pulling into terminals and stopping at locations which are in reality our light repair tracks of today where we will find adequate facilities and materials of all kinds conveniently located with a sufficient force of competent men to make inspection and repairs quickly and thoroughly under a well organized plan which will result in less handling of bad order cars and insure the possibility of accomplishing that which appears impossible.

Freight car inspection is so vital to the success of the railroad that it is necessary for our supervisors continually to stimulate interest and enthusiasm and impress this permanently in the minds of themselves, as well as on the men doing the work. If we keep both eyes open to the opportunities for improvement this cannot help but reflect a decrease in equipment failures and will assist the great common carrier of today in taking one more step in the direction of progress and fulfilling a responsibility in serving the public efficiently and safely.

Locomotive grinding.—Cincinnati Grinders Incorporated, Cincinnati, Ohio, has issued a new sixteen-page illustrated book on locomotive grinding. The machines described in this book are equipped to grind locomotive axles for the Timken tapered roller bearings.

Steam drop hammer.—Bulletin No. 205-B of the Chambersburg Engineering Company, Chambersburg, Pa., describes the construction and operation of the new Chambersburg Type B steam drop hammer, which is built in standard sizes from 600 lb. to 24,000 lb.

Hardware.—A new general catalogue, No. 27, listing and illustrating an entire line of locks and hardware for buildings, except early English and Colonial hardware, has been issued by P. & F. Corbin, New Britain, Conn. The catalogue contains 486 attractively arranged pages, bound in a dark blue cloth cover. It is provided with a numerical thumb index.

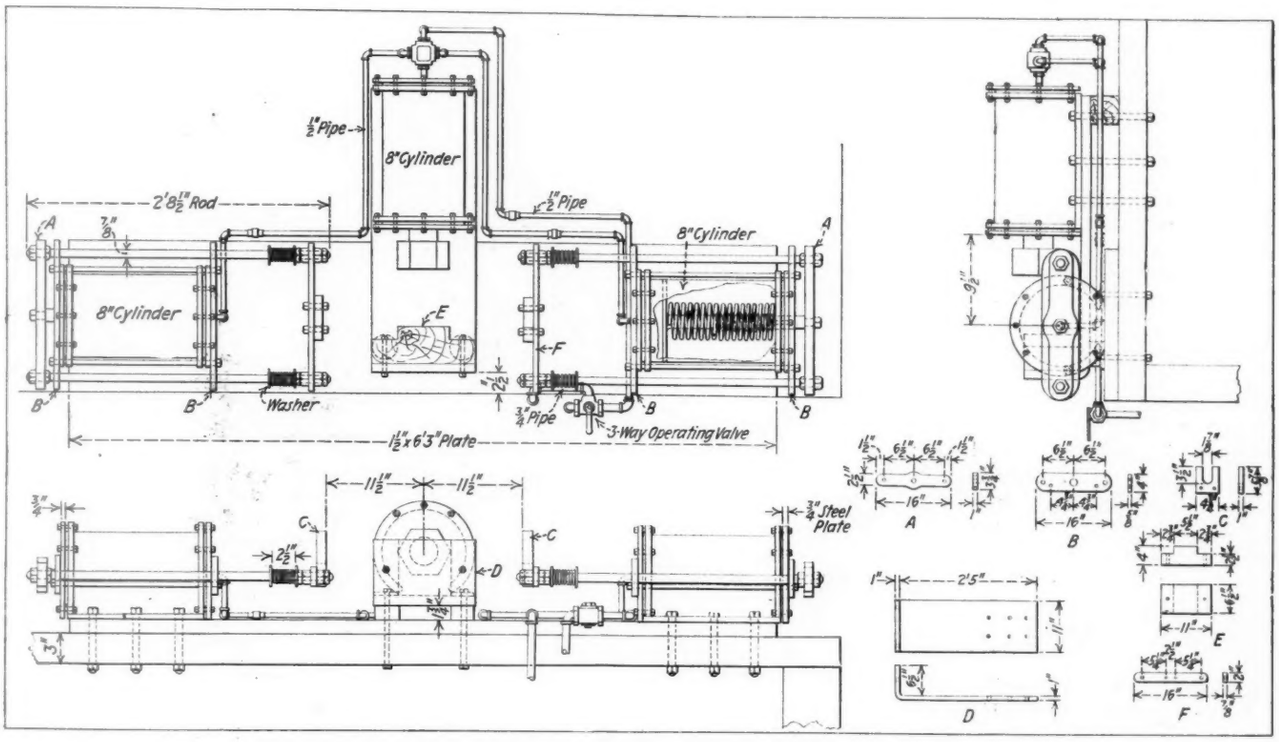
Air brake and signal hose stripping device

By Thomas Birch

Air brake foreman, C. M. & St. P., Milwaukee, Wis.

THE device shown in the illustration is one that was designed for the purpose of reducing the time consumed in the operation of stripping air brake and signal hose. The device consists of a combination of three 8-in. by 12-in. air brake cylinders, all operated with one three-way valve. After the clamp bolt has been cut, the coupling in the one end of the hose is dropped into one of the clamps *C*. The operating valve is then opened, and by piping the device as shown in the illustration, a small time element is created that causes the center cylinder to operate first. This clamps the hose in place against the buffing block *E*. The other two cylinders then operate simultaneously and the fittings are thus removed from the hose.

By the use of this device one man is able to strip about 550 hose in eight hours, and this includes the necessary trucking, the cutting of the bolts and the disposal of the separated parts.



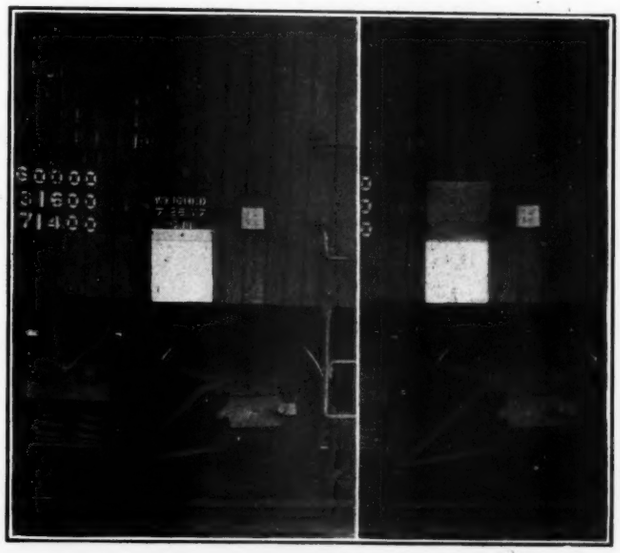
With the aid of this device about 550 air brake and signal hose can be stripped in eight hours

Making out A.R.A. billing repair cards at the car

THE Boston & Albany has adopted at its West Springfield, Mass., car shops the practice of making in one operation at the car, the original record of repairs and billing card as required by A. R. A. rules 7 and 8 and the regulations supplementary to those rules. When working out the details of the plan whereby the thin sheets of paper, which comprise the complete combination of the two cards or records, could be written on out of doors, consideration had to be given to protecting the forms from weather conditions and dirt.

The two-leaf aluminum folder, as shown in the illustration, was decided on as the best means of providing this protection. For the usual run of foreign cars the two-leaf folder is large enough. However, if a foreign car requires exceptionally heavy repairs, two folders are allotted to the car.

The proper forms are put in the folders by a clerk in the foreman's office. They are then distributed to each car by a designated person. Where possible, a small wire nail is driven into the car on which the folder is



The aluminum folders used for holding the billing repair cards are light, durable and will not corrode

hung; otherwise it is placed flat, in a closed position, on a truck bolster on the same side of all cars on the same track. The reason for always placing the folder in a flat, closed position is that rain or water dripping from the car will be kept from the contents of the folder.

The person authorizing repairs inspects the car and lists the defects on the form, at the same time inserting the car initials, number and kind of car, and draws a line through the word "loaded" when the car is empty. If the defect is of such a nature that the inspector cannot determine, by an outside inspection, the extent of the repairs to be made, he then writes down for instance, "air brake repairs" and depends on the foreman in charge to designate the extent of the repairs made.

After the repairs are made, both the inspector and the foreman check the work done against the items listed on the repair card. If the check proves satisfactory, the form is properly signed, after which the folders are collected and taken to the foreman's office. A different color of form is used for B. & A. cars. The advantage of this idea is apparent.

This method of writing up billing repair cards at the car eliminates the clerical work of writing billing repair cards. This one item is responsible for a substantial reduction in the annual payroll. It also eliminates all transcribing errors. A saving in stationary and filing space is effected by the elimination of the duplicate records.

It has had a tendency to standardize the names of car parts which heretofore had been referred to in the vernacular of the car repairmen. These men now know that the car parts repaired must be called by their right name, as they realize that the records made out at the car are official and final.

It gives the car owner correct information regarding repairs made to its cars and the reason for those repairs. In case of an argument as to responsibility for repairs, all concerned know that the billing repair card is correct if properly made out at the car, and that no errors have occurred because of transcribing.

Reinforcing freight car underframes

AT the Union Pacific repair shops, Portland, Ore., a freight car rebuilding program is being carried out which calls for an output of eight cars a day. Many of these cars, built between 1906 and 1911, have developed underframe weaknesses, and relatively inexpensive and effective methods of reinforcement are used to bring the frames back to practically their original strength or, in some cases, even more than their original strength. Three typical instances of the methods used are shown in the illustrations.

Reinforcing plates, both plain and flanged, play a large part in strengthening weak points in the under frames, but the greatest economy is effected by the use of cast-steel channels, brackets and other shapes, which in certain places perform their function of stiffening and strengthening the underframes better than flanged

Fig. 1—Reinforcement by means of heavy plates riveted to the body bolster and center sill

plates, and cost less because made in Portland and not subject to heavy freight charges from eastern steel mills. For example, a cast-steel bracket used in strengthening the connection between center sill and body bolster is illustrated in Fig. 3, a bracket before application being shown on top of the underframe. The superiority of this bracket over a flanged shape is apparent.

The method of reinforcing box car center sills and body bolsters is illustrated in Fig. 1. A top transom plate, bent to the shape shown, passes over the center sill and is riveted to the body bolster. It will be noticed that the center sill itself has been reinforced at this point by a cover plate of substantial proportions.

Fig. 2—Center sill and bolster reinforced by means of cast steel channel and heavy cover plate

The application of ¾-in. cast-steel channels for center sill reinforcement is illustrated in Fig. 2. Certain classes

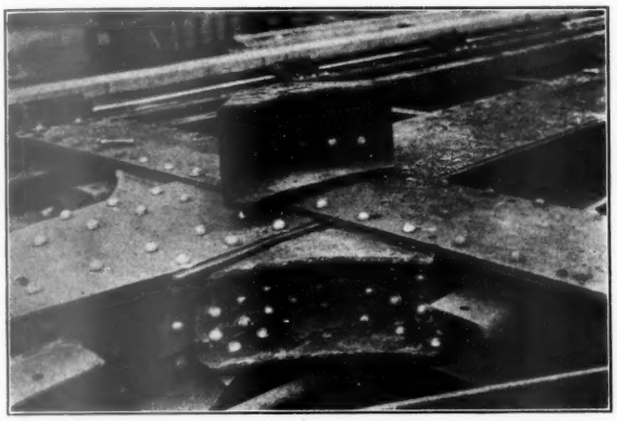


Fig. 3—Cast steel bracket used for strengthening underframe and body bolster connection

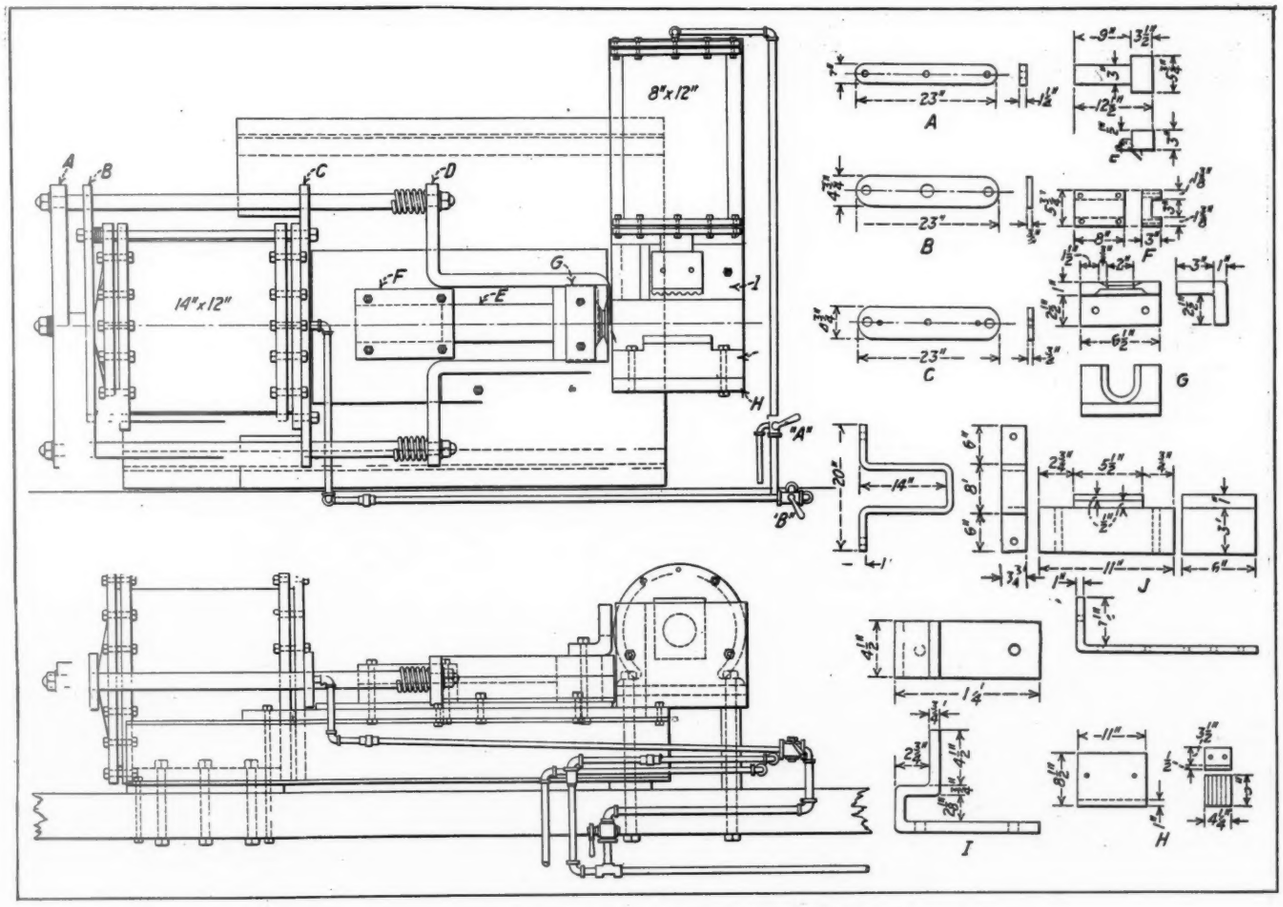
of cars being rebuilt at Portland shops have developed a weakness at this point and experience has shown that cast-steel channels, applied with an adequate number of rivets carefully driven, afford an effective means of overcoming the difficulty. The body bolsters of these cars also require reinforcement, which is taken care of by the application of a wide ¾-in. tie plate which passes over and is riveted to the center sill as well as to the body bolster. This is also shown in Fig. 2.

A handy steam hose stripping device

THE stripping of fittings from old steam hose is, at its best, a laborious job, due chiefly to the vulcanizing that takes place when the hose is constantly subjected to steam pressure. Unless some means is devised for pulling these fittings out it is almost impossible to remove them.

Undoubtedly, there are numerous other devices for doing this work but we have developed one that has proved efficient and makes the task of stripping steam hose very light.

This device is shown in detail in the illustration. The nuts on the clamp bolts are first removed with a reversible air motor, and the clamps knocked off. The fillet of the nipple is then placed in the bracket *G*. Valve *A* is then opened and through it air pressure flows to the 8-in. cylinder, thus forcing the piston out and securelly clamping the hose against the block *J*. Valve *B* is then opened and air pressure flows to the 14-in. cylinder, forcing the piston out, which, with the aid of side rods, carries with it bracket *D* to which is fastened bracket *G*. The hose fitting is forced off as the cylinder piston moves out.



General arrangement and details of device for stripping steam hose

The time consumed in stripping one hose, including the necessary trucking to the machine, the removal of the nuts, bolts and clamps, and the disposal of the separated parts, amounts to about two and one-half minutes.

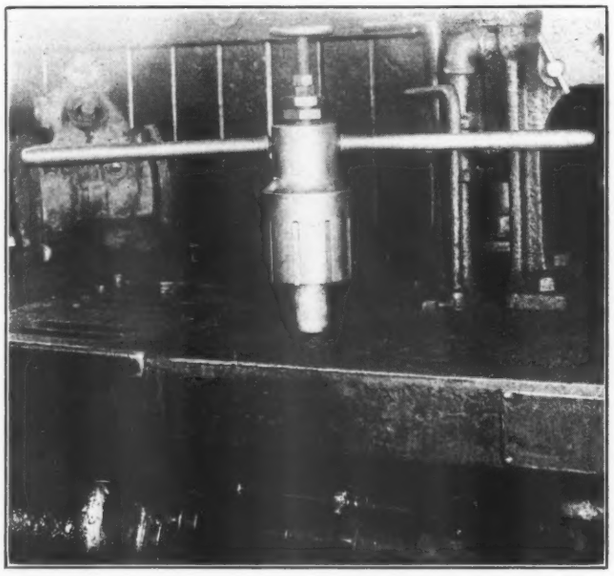
Triple valve piston bushing reamer

By Glenn L. Davis

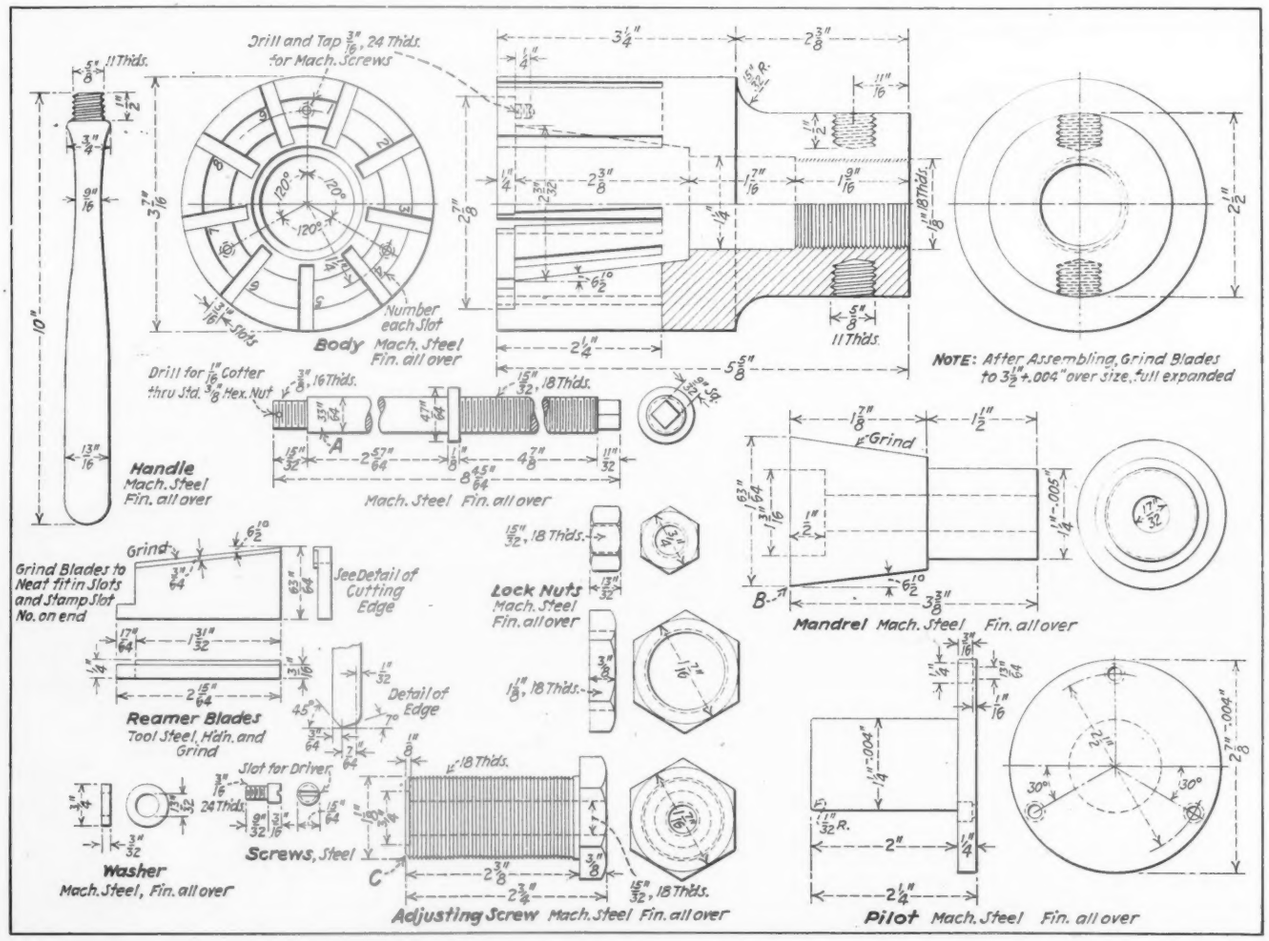
TRIPLE valve repairs require the mechanic to work with close tolerances so that the finished product will function properly on the test rack. To obtain precision work it is essential that accurate tools be used. The triple valve piston bushing reamer shown in the illustration has been designed to assist the mechanic employed in the air brake repair room to perform accurate work when reaming piston valve bushings.

The sketch shows in detail, the construction of the reamer. The outward or expanding movement of the cutter blades is effected by turning the hand wheel at the top of the reamer. In order to maintain the required tolerance of .004 in. over the nominal size of valve, the movement of the mandrel is limited by the adjusting screw *C*, which acts as a positive stop for the mandrel and which is secured by two lock nuts on top of the body of the reamer. In practice, the adjusting hand wheel is turned to lower the mandrel and collapse the blades to an easy entrance into the triple valve body. The blades are then expanded by reversing the hand wheel until the mandrel is brought up to the limiting position of the adjustment screw *C*, the detail construction of which is shown in the lower center of the drawing.

In the original design of the cutting blades, they were ground with a 45-deg. negative rake and a 7-deg. clearance. Since this was not entirely successful in producing a smooth finish in the brass bushing of the valve, these blades are now ground with no rake and with a 2-deg. clearance which gives satisfactory results for this work.



The reamer ready for insertion into the triple valve cylinder body


Drill and Tap 3/16", 24 Thds. for Mach. Screws
Body Mach. Steel Fin. all over
Number each Slot
Drill for 1/16" Cotter thru Std. 3/8" Hex. Nut
Handle Mach. Steel Fin. all over
Grind
Grind Blades to Neat fit in Slots and Stamp Slot No. on end
See Detail of Cutting Edge
Reamer Blades Tool Steel, H'dn. and Grind
Detail of Edge
Slot for Driver
Washer Mach. Steel, Fin. all over
Screws, Steel
Lock Nuts Mach. Steel Fin. all over
Adjusting Screw Mach. Steel Fin. all over
Mandrel Mach. Steel Fin. all over
Pilot Mach. Steel Fin. all over
NOTE: After Assembling, Grind Blades to 3 1/2"+.004" over size, full expanded

Details of the tool for reaming out triple valve piston bushings

New diner and club-lounge cars prove successful

Merit of unusual features of design demonstrated by over a year's service on the Santa Fe

IN August, 1925, the Atchison, Topeka & Santa Fe placed in service on its through trains to the Pacific coast a new all-steel diner and club-lounge car combination designed to give more adequate and better dining car service, to eliminate any waiting in aisles for satisfactory seats, and in general to provide all conveniences now available on the best modern passenger trains, such as a comfortable lounge and smoking room, soda fountain, book store, candy shop, cigar stand, barber shop and shower bath. These cars, with a few minor changes, proved popular and successful from the first, and nine additional two-car units have now been built by the Pullman Car & Manufacturing Corporation, or enough to equip the first section of each of the Santa Fe's California Limited trains.

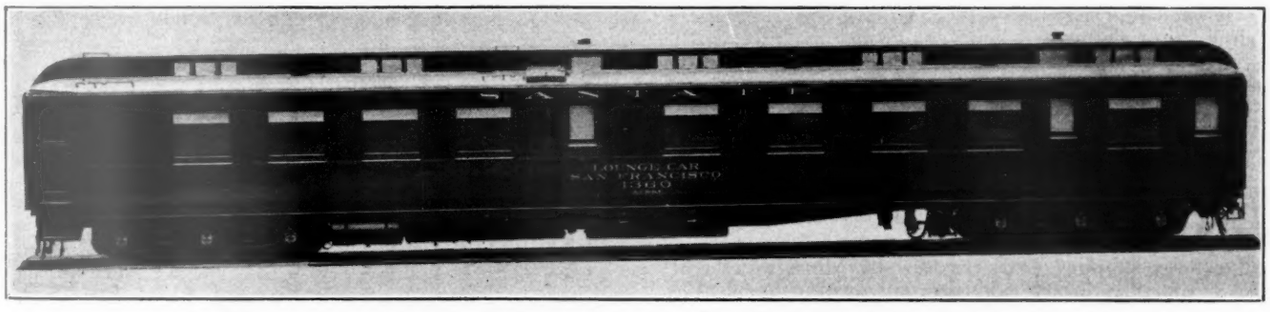
The cars are operated coupled together, at the head end of the train, with the *A* end of the club car next to the diner and the *B* end next to the first Pullman sleeper. Referring to the dining car floor plan, the absence of vestibules and narrow passageways will be noted. There is but one public entrance and that is from the club-lounge car directly into the dining room proper. When all seats are occupied, additional passengers desiring dining car service simply wait in the club-lounge car, occupying comfortable Pullman sections reserved for them in the *A* end of the car, or passing further back to the smoking and lounge room if that seems preferable. The amount of personal dining service required by railroad passengers at their individual sections or compartments has increased greatly in recent years and the absence of narrow passageways in the new Santa Fe diner expedites this service also, since waiters with loaded trays are no longer obliged to crowd their way by passengers who, in the absence of other arrangements, must stand in the passageways while waiting for dining car seats.

Dining car capacity increased 50 per cent

By eliminating the diner vestibules and passageways considerable space is conserved, and an unusually roomy kitchen and pantry occupy less than the ordinary length in one end of the car. The resultant aggregate saving in space is utilized by increasing the number of seats in the dining room from the usual 30 or 36, to 42. This greater seating capacity, coupled with more expeditious service, due to the improved kitchen and pantry arrangement, make it possible to serve comfortably 50 per cent more people in a given time than with the usual dining car arrangement. This increased capacity avoids the necessity of two diners on crowded through trains, and on trains having less traffic the older diners still give effective service.

Smoking room in the club-lounge car separated from the passageway by a glass partition—Cigar stand at the far end

The kitchen and pantry deserves special note because of their roominess, equipment, and arrangement to eliminate lost motion in preparing and serving food. On receiving orders from the guests the waiters take them to the pantry, collecting on trays the various parts of their respective orders. The silver and glassware, as well as fruit, salad, cream, ice cream, etc., are obtained in the pantry where everything is conveniently located, and a pantry man is in charge who also serves as a waiter part of the time. Meat, fish, vegetables and the more substantial parts of the orders are secured at the steam



Club-lounge car built for the Santa Fe by the Pullman Car & Manufacturing Corporation

table which extends almost the full width of the car and is separated from the pantry by a space about 30 in. wide. With this steam table there is no crowding of several waiters at the usual small opening to the kitchen, and much time is saved. The steam table is also provided with two Stearnes 10-in. coffee urns and an Espy Curtis automatic egg boiler.

Just before re-entering the dining room proper, the waiters pass a checking station where an employee acting as checker and cashier looks over the trays, checks the individual items and writes the total amount of the bill. After serving the meal, the waiter takes the bill together with the money offered in payment directly to the checker and in case change must be made returns it immediately to the guest. This saves time normally spent waiting for the steward who is now enabled to give his entire attention to the guests.

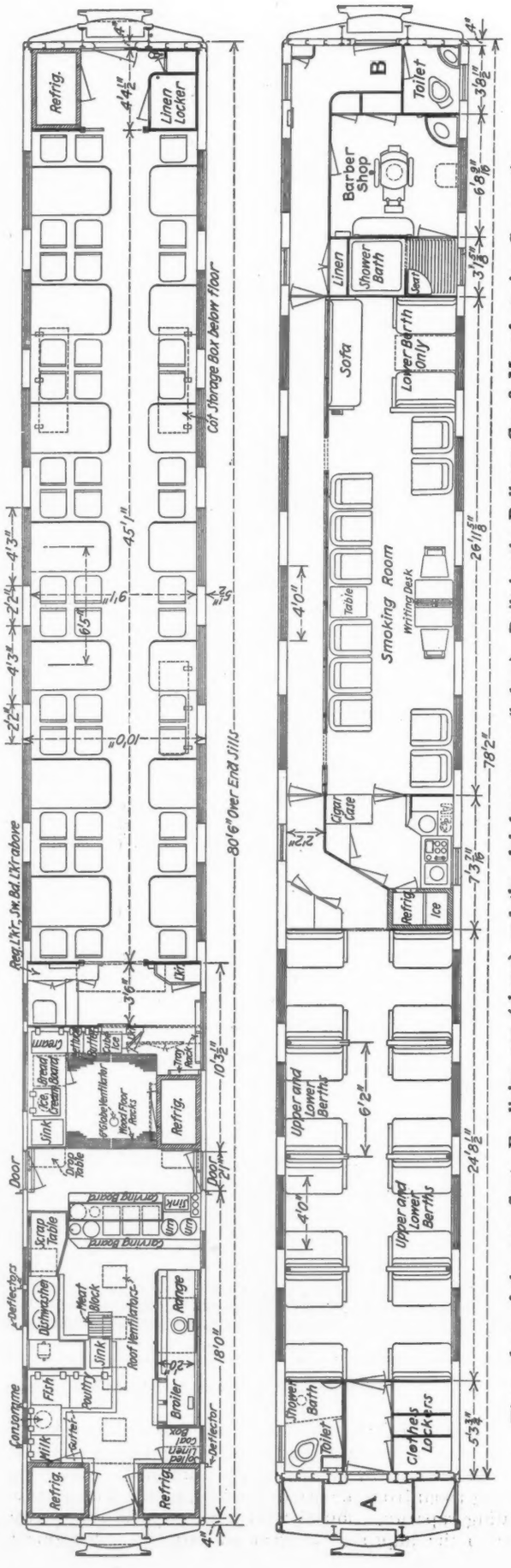
In the kitchen and pantry, steel interior finish is applied, white metal being eliminated wherever possible and replaced by Monel metal. Adequate ventilation is provided by means of four standard Santa Fe type upper deck ventilators, in addition to which, deflectors of special design applied to the windows assist in keeping the kitchen at a comfortable working temperature. It will also be noticed that the kitchen arrangement is such as to permit the help to get away from the heat of the range and broiler at will.

The kitchen equipment includes, besides the steam table mentioned, a large Stearnes coal range, a broiler, fish and poultry boxes, a milk container, meat block, dish washing and sterilizing equipment, and two large refrigerators. Sinks, tables and lockers are available where needed. By raising a hinged shelf over the dish washer trainmen can pass through the kitchen if emergency requires.

Particular attention has been paid to the design of the refrigerators, and the three-day run from Chicago to Los Angeles is made with but one filling of ice. This permits maintaining the food at a more uniform temperature, necessary for its proper preservation, than where ice boxes frequently become nearly empty. The refrigerators are cork lined and have a combined ice compartment to be iced from the roof by means of a hatch and plug in the center of the upper deck. An inverted V-shape apron placed in the center of the hatch opening, diverts the ice to both boxes. The large provision wells or boxes for poultry, fish, milk, etc., are also built to maintain the desired temperature and are cork lined throughout. Monel metal meat pans are used on the steam table.

The pantry is designed large enough to prevent interference of the waiters with each other in the performance of their duties—another helpful influence in speeding up the service. The general pantry arrangement is compact, with the necessary equipment such as dish service shelves, fruit refrigerators, butter, cream, ice cream and cube ice containers all located for maximum convenience. A wooden floor mat is provided, G. S. Woods rubber tiling being used at the pantry entrance. A cork-lined refrigerator in the pantry takes care of bulk pantry supplies, and an additional storage refrigerator is installed in the opposite end of the diner. Opposite the latter are lockers to hold the dining room and kitchen linen.

The dining room presents a particularly rich, well-lighted appearance. The interior finish is steel throughout with stippled walls of a light maple color and black trimmings. The upholstering is in red leather and the carpet a Creston-Wilton of special pattern. Bauscher chinaware and Albany pattern silver from Sheffield, England, are used.

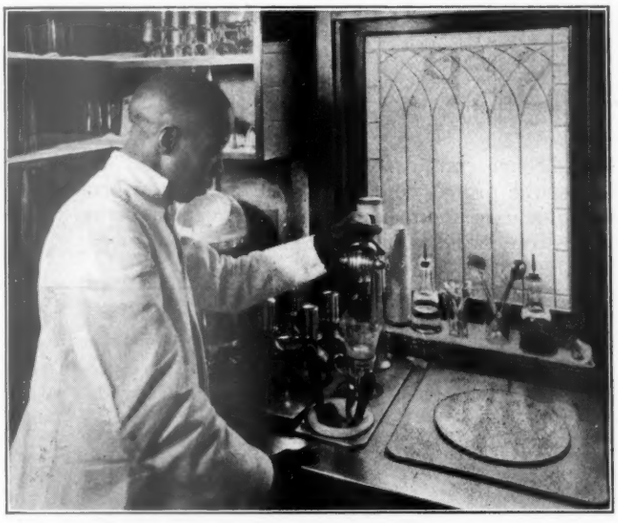


Floor plans of the new Santa Fe dining car (above) and the club-lounge car (below)—Built by the Pullman Car & Manufacturing Corporation

Club-lounge car

The *A* end of the club-lounge car, reserved during the day and evening for guests unable to find seats in the dining room, is closed to the public late at night and serves as sleeping quarters for the dining car crew, thus avoiding the necessity of the crew sleeping in the diner itself. Clothes lockers and a separate toilet and shower bath are provided for the crew in this end of the club-lounge car.

Besides the 16-seat Pullman section, cut off by a partition, a beautifully appointed smoking room is provided with 10 Heywood-Wakefield wicker lounging chairs, two writing desks, an extension sofa, a lower berth section, magazine table, mail box, etc. The smoking room is separated from the direct passageway to the diner by a low glass partition which permits the entire width of the car to be decorated and treated as one room, at the same time preventing any disturbance of guests in the smoking room by others on the way to the diner. Buffet service in charge of a competent man is installed and



A completely appointed soda fountain is part of the club-lounge car equipment

includes a small soda fountain with electric mixer and juice extractor, cigar stand, and facilities for the sale of candy, cigars, cigarettes and magazines.

A specially-designed refrigerator is provided for buffet supplies which must be kept cool. The completely appointed barber shop includes a barber chair, folding seat and wash stand, together with the necessary electrical equipment. In connection with the shower bath, there is a dressing room, separated from the shower proper by means of a waterproof curtain. Ample water supply and a means of heating the water have been arranged by the use of additional water tanks and heating drums. The same steel interior finish and red leather upholstery is used as in the diner. Lighting fixtures for the car are furnished by the Safety Car Heating & Lighting Company.

Both the diner and club-lounge car are built in accordance with Santa Fe standards, having a body construction of steel throughout; Commonwealth cast steel trucks with integral pedestals, Symington malleable journal boxes and Standard 37-in. rolled steel wheels. Miner self-locking center pin and B-10 friction bumper are also specified on these cars, which are fitted with Barber No. 12 roller side bearings. Simplex clasp brakes and Diamond S.U. brake shoes are used. These cars are equipped, some with Miner A-5-X, some with Bradford rocker type R-50, and some with Waugh P-24-G draft gears.

General construction

More than the usual amount of insulation has been provided, that in the floors consisting of two courses of ½-in. hair felt and ½-in. Insulite, respectively, covered with ⅛ in. of petroleum asphalt, mopped on hot. The sides, ends and roof are insulated with two courses of three-ply Salamander. O. M. Edwards sash locks and fixtures are used. The window shades are made of Du Pont Fabrikoid, shade fixtures being furnished by the Curtain Supply Company. Each car is heated by a Vapor thermostatic steam heat system, Vapor metallic steam heat system, Vapor metallic steam connections also being provided between the cars. Ten Peerless ventilators, furnished by Mudge & Company, are employed in each lounge car and seven in each diner. Okonite wiring is used throughout, with Galvaduct conduit, Crouse-Hinds switch boards and Oliver two-finger train connectors. Westinghouse type U.C.-2-14 brake equipment is used, employing 60-lb. brake cylinder pressure and lever proportions which provide braking power up to 90 per cent of the light weight of the car. The Lindstrom type handbrake is provided.

The new Santa Fe diner and club-lounge cars are built in accordance with drawings and specifications furnished by J. T. St. Clair, engineer of car construction of the Santa Fe. The dining car floor plan and equipment, and particularly that of the kitchen and pantry, were developed by Byron S. Harvey of the Fred Harvey System, Chicago, and patents have been granted to Mr. Harvey for his ideas contributed to nine features of this construction.

DECALOGUE OF SAFETY.—L. G. Bentley, chairman of the committee on education of the Safety Section of the American Railway Association, in circular No. 135, places before the railroads, in his general campaign for safety "all the year—every year," the safety program of the Section for the month of November. This program specializes on three subjects: (1) casualties to passengers, (2) casualties to trespassers, and (3) value of competent first aid. The difference in importance of different classes of causes of accident is illustrated in this circular by outline sketches of men of different sizes. The figure which illustrates the number of "adult citizens of community value" killed and injured while trespassing is about three times as large as the man representing the total of those trespassing victims who are classed as tramps.

The importance of first-aid is set forth in a dialogue, illustrated, concerning two men who suffered slight injuries, one of whom neglected the matter and had to have his arm amputated, while the other went promptly to the first-aid specialist and lost no time from his duty.

The poster accompanying this circular sets forth a "decalogue of safety," as follows:

1. *Don't* board passenger trains unless you are a passenger.
2. *Don't* attempt to get on or off a moving passenger train.
3. *Don't* be careless in stepping on or off a standing passenger train.
4. *Don't* stand on platforms or in open doors of passenger cars.
5. *Don't* place hand or arm under an open window.
6. *Don't* attempt to get on or off or crawl under a freight train under any circumstances.
7. *Don't* cross railroad tracks without looking in both directions. If view is obstructed, stop, look and listen.
8. *Don't* attempt to cross tracks in front of an approaching train.
9. *Don't* walk or stand on railroad tracks.
10. *Don't* allow your children to play around railroad tracks or trains.

This is a *personal matter* to you and the welfare of your family.

Interesting devices at Sacramento shops of S. P.

IN connection with its extensive locomotive repair and construction work, at its Sacramento, Calif., shops, the Southern Pacific has developed many labor-saving methods and shop devices. Owing to the long distance from the eastern steel centers, modern, well-equipped foundries are operated at these shops for the manufacture of practically all iron, brass and steel castings, except the largest, used in locomotive and car maintenance work. The steel foundry is equipped with a six-ton electric furnace, and one of the photographs affords a striking illustration of the operation of casting

Casting the first steel cylinder for 2-10-2 type locomotive

the first steel cylinder for a 2-10-2 type locomotive being built in the locomotive shops. This casting weighed 8,500 lb.

A photograph and detail sketch show the method of providing cast-steel piston heads for heavy power with solid bronze rims cast in place. This practice, with the use of the proper constituents in the molten bronze and with due care in annealing, provides a construction which is entirely satisfactory, and eliminates the need of ex-

Forty-inch steel pistons with cast brass rims

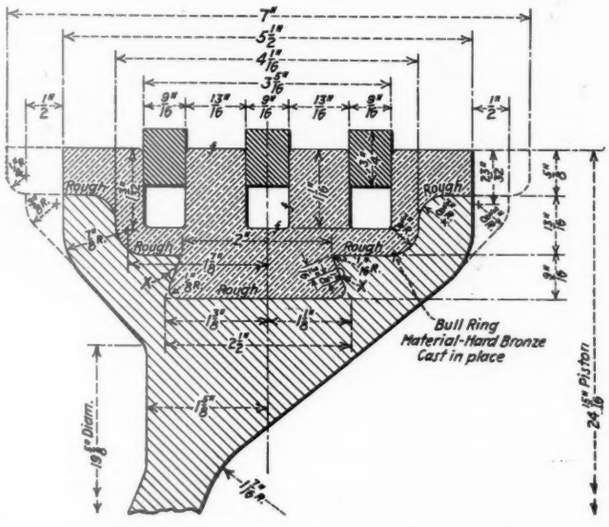
tended piston rods on large Mallet locomotives. Extensive service tests have shown that it is durable, obviates difficulty from rivets working loose as in other constructions, and promotes increased cylinder life between borings.

For turning the ball joints on Mallet receiver pipes, the jig shown in another illustration is used to advantage. The receiver pipe is clamped to the boring mill table in the usual manner and one tool-post with a swiveling attachment adjusted to hold the fulcrum at the center of the radius, finishes the joint surface. (This point must also be in the vertical center line of the boring mill table.) The second tool post then is used to feed the cutting tool downward on the required radius as the boring mill table revolves.

In the device for cutting the radius of cylinder saddles on a Morton draw-cut cylinder planer, the fulcrum

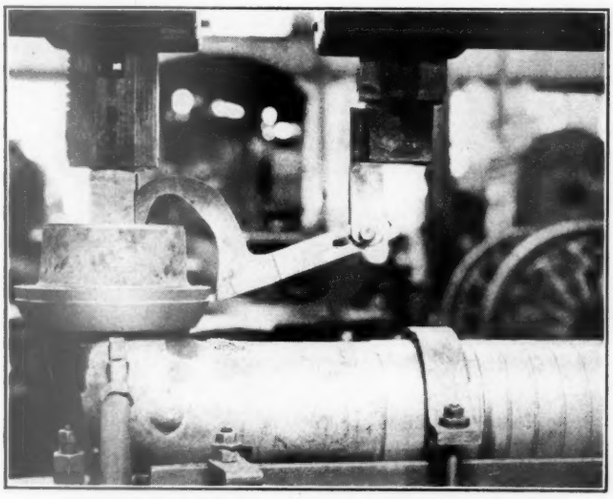
arms and also the tool-post arm are adjustable to suit the saddle radius and to locate correctly the fulcrum point. A pin and slide connect the tool-post arm to the draw head. Operation of the draw-head then causes the cutting tool to move in the correct arc.

Mallet cylinder saddles also are machined at the



Details of brass rim cast on piston head

Sacramento shops, the radius in this case sometimes being as great as 42 or 43 in. This particular job is usually done on a large planer with the cutting tool in a special holder of the required length to give the correct radius and supported on the back by a substantial steel bar securely clamped to the planer side frames.



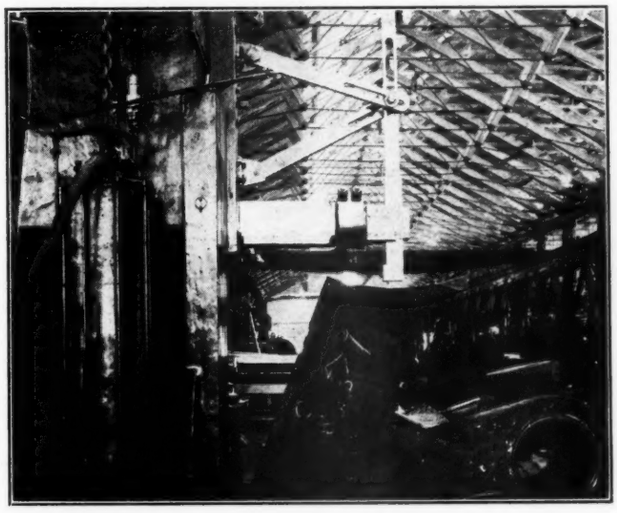
Method of turning ball joint for a receiver pipe

The radius feed is controlled by the cross-feed of the opposite planer head.

For milling the teeth of reverse lever quadrants, a special jig is used on a Gould & Eberhardt universal gear cutter. In this case, the quadrants are supported in a jig, fulcrumed to give the proper radius. Jaws at the radius rod ends hold two or in some cases more quadrants, the teeth of which are formed by a multiple tooth cutter. A more than usually accurate job is obtained by this method.

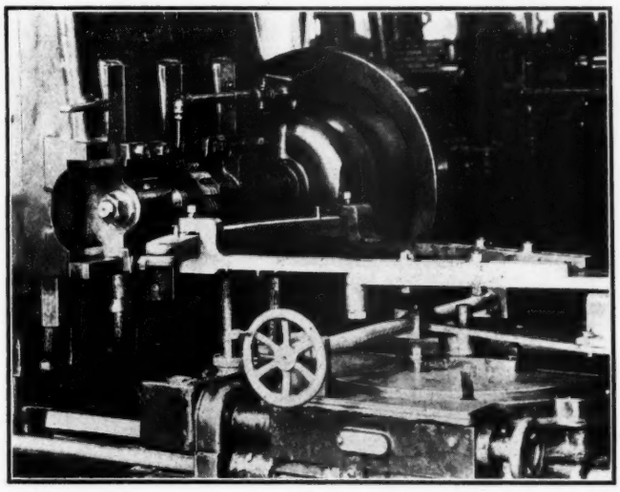
A special jig has been developed for the uniform drilling and tapping of eccentrics. Set screw holes and stud holes in the eccentrics are quickly and accurately drilled by means of this device. The three positions in which the eccentric must be held for this work are positively located by suitable taper stop pins which extend through the face plate into the swivel part of the jig. The eccentrics are held by a clamp with the two set screws, this arrangement enabling them to be quickly applied and removed. The templates for locating the holes are shown in the illustration on the drilling machine table. By employing the required templates, this jig can be used for all classes of eccentrics used on Southern Pacific locomotives.

Mud rings are sometimes machined at the Sacramento



Machining cylinder saddle radius on a Morton draw-cut cylinder planer

shops on the boiler plate planer by the method shown in one of the photographs. A cast-steel head, mounted on a carriage, is propelled by the horizontal feed screw of the machine and carries two vertical tool slides for planing the inside and outside of the mud rings at the same operation. These slides are each equipped with

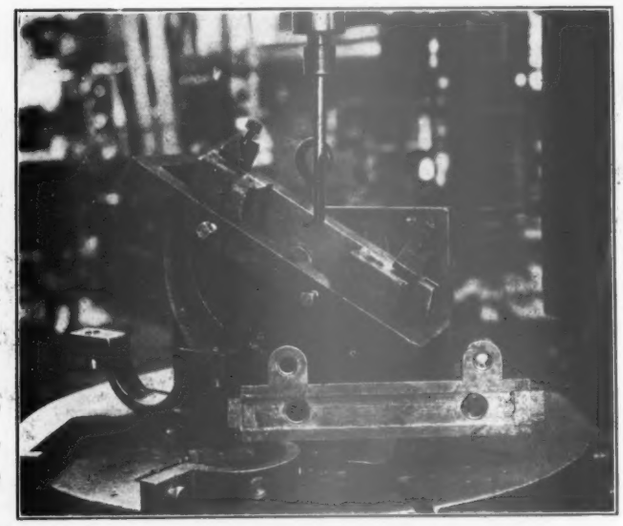


Milling teeth on reverse lever quadrants on a Gould & Eberhardt universal gear cutter

two cutting tools and cutting is done on both the forward and reverse strokes of the carriage. The slides are fed downward by a cross-feed rod with two small bevel gears driving similar bevel gears keyed to the re-

spective tool slide screws. Feeding in this instance is done by hand.

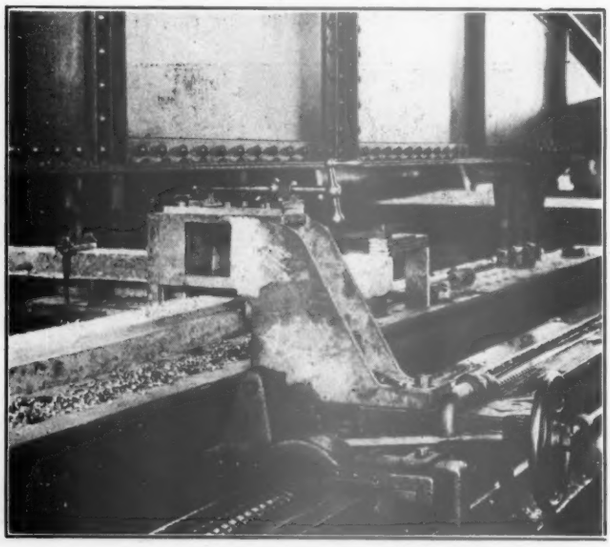
A feature of the work at the Sacramento shops is the accuracy secured by the extensive use of micrometers. Shop-made micrometers are available in all standard sizes from 1 in. to 42 in. The frames are made of aluminum, with micrometer ends accurately and substantially secured in place. The light weight of these micrometers even in the largest sizes enable them to be handled for long periods without causing undue fatigue, a feature which promoted their more extensive use.



Jig used in drilling and tapping eccentrics

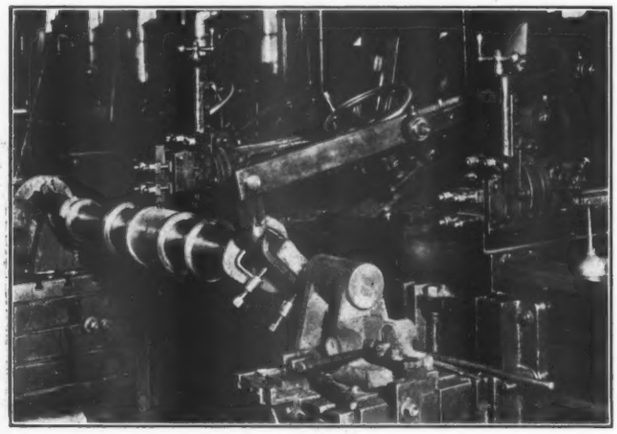
They enable accurate fits to be made and save much time which must otherwise be spent in frequent trips between machine and job.

While not many railroad shops are confronted with jobs identical with that in the illustration showing the turning of a partially cylindrical surface on a shaper, this



Jig for machining mud rings on a boiler plate planer

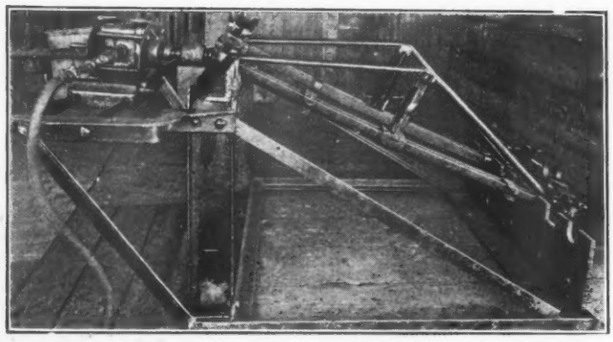
is an interesting method of performing a more or less common machining operation. The part illustrated is a steamship engine crosshead, the middle section of which is in the general form of a cam with three-quarters of the surface a true cylinder. In order to machine this partially cylindrical surface, the crosshead is set in boxes on the two tables of a double-head shaper. One head is provided with the customary cutting tool which is held stationary (as far as reciprocating motion is concerned) and adjusted to the vertical center line of the cross head.



Ingenious method of turning part of a cylindrical surface on a double head shaper

The No. 2 head of the shaper is then arranged to give the shaft a partial revolution forward and backward by means of the standard shaper crank arm. By feeding the No. 1 shaper head and cutting tool parallel with the crosshead center line a partially cylindrical surface is formed.

One of the extensive features of railroad reclamation work is the repair and reconstruction of brake beams. The jig illustrated is effectively used at the Sacramento



Brake beam nuts are quickly applied and removed in this device

shops for the removal and application of brake beam tension rod nuts. In this case a reversible air motor is mounted on a frame having horizontal movement on two 1-in. pipes, with ¾-in. tie rods extending through them. The motor has a short transverse movement on suitable ways so that the nut socket can be made to engage and disengage the nut on the brake beam rod. This device is foolproof and eliminates the danger encountered when it is attempted to hold the motor by hand while backing off or applying nuts. Time is also saved by this device.

GRINDERS.—The Machinery Company of America, Big Rapids, Mich., describes and illustrates in a four-page bulletin a 220-in. cabinet base traveling wheel grinder. This grinder, when fitted with suitable revolving work table, can be kept in practically constant operation by revolving the table into position when one job is completed and starting at once on the next.

Standardizing hack saw blades

Specifications based on simple shop tests leave chemical composition and heat treatment to discretion of manufacturer

*By Robert Job**

Vice-president, Milton Hersey Company, Ltd., Montreal, Que.

A HACK SAW blade is a small but very useful and necessary item of machine shop equipment, and a great deal of delay and inconvenience can result when the blades fail to do their proper amount of work at a proper rate.

Composition and method of manufacture of the steel, mechanical arrangement and setting of the teeth and subsequent heat treatment all have a most important bearing upon the ability of the blade to cut quickly and to maintain a good life and satisfactory output. The combination of chemical composition and heat treatment necessary to ensure good service under the usual conditions have been pretty well worked out, but blades at times fall far below such standards, and in the stress of competition the best practice is not always maintained and cannot be assumed to be present.

Various specifications for hack saw blades have been developed but they have been found inadequate in different ways, particularly because the tests called for could not be performed at different shops with the same result, and dissatisfaction and uncertainty upon the part of both manufacturer and purchaser was bound to follow. With these things in mind we decided to tackle the problem afresh, eliminating unnecessary tests and incorporating those only which were considered essential to ensure proper performance of the blades.

Service and not composition is the objective

Composition is unquestionably an important factor and the same is true as to arrangement and setting of the teeth, but in actual shop tests we found blades which, though considerably outside of the usual range of composition, nevertheless had excellent practical ability to cut,—much greater in fact, than other blades which were more orthodox in their chemical make-up. The difference was due to the excellence of the heat-treatment, and in view of these conditions we reached the conclusion that composition, mechanical arrangement and heat-treatment were details—and very important ones—which should properly be left to the discretion of the manufacturer. At the same time it was equally clear that the ability to cut, and the life and endurance of the blade under shop conditions should be specified so clearly and definitely that the tests required could be carried out with close agreement at any shop having ordinary standard equipment.

The cutting test thus became an important element, and the details were carefully considered and worked out after conferring with various manufacturers. For the actual test a medium carbon steel bar, annealed, was decided upon, containing for convenience 65 per cent to 75 per cent carbon, with Brinell hardness of approximately 200. A square bar was selected in order that the depth of cuts could be measured easily, and the dimension 1¾ in. sq. was decided on so as to get a good amount of cut and of wear within a reasonable time. In order to secure uniformity in the test the human element was eliminated as much as possible and all tests were made on the power saw, both power blades and hand blades.

Saw operating conditions standardized

This work led to the standardizing of the conditions of operation of the power saw. Shop speeds vary materially in different places and often in the same shop. Blades are often ruined by excessive speed and insufficient pressure, and after investigating this feature carefully we decided upon a speed of 60 strokes per minute. This represents good standard practice,—not rapid enough to overheat and ruin the teeth and yet fast enough to ensure a good volume of work without straining the machine or the blade. We also specified that the blade must be lifted above the test bar upon each back stroke, a simple commonsense precaution which is not by any means always taken, but the disregard of which leads to a short and ineffective life of the hack saw blade.

The weight with which the blade rests upon the bar during the sawing is obviously important; if it is too heavy the saw is liable to buckle and break, while if too light the teeth do not properly grip and become quickly worn. To determine just what weight was required we took a standard steelyard scale and carefully determined the number of pounds necessary to raise the blade from the work after the weights had been carefully adjusted by an experienced mechanic. These weights were determined both at the beginning of the cutting, and again in the case of power blades after 30 strokes, when the blade was cutting smoothly and after the second weight had been placed in position on the bar. In order to determine this weight, the hook of the steelyard was placed under the top of the arm of the power saw over the standard steel bar at the middle of the stroke. Just enough of a lift was then given to raise the blade from the steel bar, and the weight with which the blade rested upon the bar was thus quickly and easily ascertained.

As a result of this work it was found that with a 10-tooth power blade there should be a pressure of 60 lb. upon the test bar during the first 30 strokes, and of 90 lb. subsequently. In the case of hand blades a pressure of 20 lb. throughout the test was adopted as a result of experimental runs.

In standardizing any power saw the actual weight need be taken only a few times, and the weight-bar of the power machine can then be notched so as to be put quickly in the proper position if it should at any time be displaced. For test of hand blades upon the power machine the weight-bar can be reversed, with a single weight so regulated as to bring the total weight with

*Mr. Job serves as chemist, Canadian National, and assistant chemist, Canadian Pacific.

which the saw rests upon the test bar at the middle of the stroke to 20 lb.

Tests require less than an hour

After thus determining and standardizing the conditions of test we next made actual cutting trials upon the standard 70 per cent carbon steel bar, 1¾ in. by 1¾ in. Different makes and sizes of blades were used and limits were finally arranged which admit the quality considered satisfactory at the shops with a fair working margin, and reject the slow cutters. These cutting tests were carefully conducted using an accurate stop watch.

In making this test we figured that five cuts of the test bar should give the necessary information when using a power saw, these cuts being made in not exceeding 25 minutes with a 10-tooth blade, while with the hand blades the number of cuts was regulated with the number of teeth so that the test could be completed in less than one hour.

The rate of deterioration of the blade during the progress of the test was obviously important and this was safeguarded by specifying a maximum percentage of increase in time of the last cut as compared with that of the first cut, the percentage being determined by shop tests.

Turning again to the quality of the steel, it was necessary to avoid undue brittleness, and in order to measure this we took a number of makes of blades said to be satisfactory, and determined the diameter of the bar around which they could be bent readily without failure. We also recognized the fact that in any shop a blade was liable to be twisted through accident, and we therefore measured carefully the amount of torsion which a good blade of different types would readily withstand without fracture, and fixed upon good workable limits for the proposed specifications.

Practicable standards of flexibility

In many shops two qualities of blades are obtained; namely, all hard, and flexible or hard edge. The all hard blades are used for general work and the flexible for work in which the blade is liable to be severely strained owing to the character of the work or the inexperience of the labor.

The all hard is the standard grade and is relied upon where the conditions of service are reasonable and the blade is not likely to be seriously twisted or bent. Of the flexible grade there are many different varieties. Some are so deficient in cutting ability as to take two or thre time as long to do a given amount of work as required with a good all hard blade of the same dimensions, and the teeth quickly become dull. Some grades, however, though having a soft, bendable back, have also a hard cutting edge, and if properly used under standard conditions would cut through the standard steel bar in the same time as the all hard blades. Consequently in drafting specifications we were able to retain the same time limits for the cutting test with the flexible blades as with the all hard blades of the same number of teeth, but the bending test prescribed that the flexible blade must bend around a two-inch diameter bar without breaking into two or more pieces. Under this severe bending test the hard cutting edge of the blade cracks but the soft back prevents the blade from breaking. This is all that can be expected or desired under such severe conditions of maltreatment. In addition, a torsion test of 270 deg. is specified for the flexible grade, as compared with only 180 deg. for the all hard hand blades and 60 deg. for power blades.

The above statement will serve to indicate the reasons which led to the adoption of the tests and limits finally drafted into the specifications. None were inserted which did not serve a definitely useful purpose, and all were derived from actual shop performance of blades of good standard quality. In making the cutting test it was decided to use cutting compound in order to ensure greater uniformity than would otherwise have been likely.

Questions the tests will answer

A couple of instances will serve to show the practical value of the system of test outlined above. In the first case several flexible blades, 14 teeth per inch, were sent in for test with the statement that they did not cut properly and quickly became dull. A cutting test was made with one of the blades submitted, with the result that the actual cutting time for the five cuts of the standard bar was 150 minutes, as compared with a maximum of 52 minutes permitted in the specifications. Such a blade would cause unnecessary expense, delay and inconvenience in shop operations. The unsatisfactory condition of the blade was definitely shown as a result of the test, and arrangements were made accordingly.

In another instance complaint was made that the blades did not stand up properly and quickly lost the cutting edge. In this case an examination of the teeth under a magnifying glass showed that the tips had been bent, indicating that the blades had been dragged over the work upon the back stroke instead of being raised above the work as should have been done. A cutting test made with one of the unused blades proved that the cutting time was well within the specification requirements. The failure, therefore, was due to careless shop practice, and the blades, properly handled, were found fully up to standard. In each instance we were thus able definitely to fix upon the real cause of the failure.

The investigation of hack saw blades was undertaken at the suggestion and with the co-operation of the Lehigh Valley. Most of the detail tests were made at the shops of the Canadian National, and the specifications, which are included, are essentially those adopted by the latter road.

Specifications for hack saw blades

1. Size and dimensions

Shall be as specified in the order and conform to the standard drawings of the ———————— Company.

2. Composition

Tool steel of such composition and heat treatment as will enable the blades to meet the requirements of these specifications. The ends of all blades shall be so treated as to prevent the holes from pulling out when the blade is in tension between holders.

3. Bending test

The blades must stand bending evenly and closely around a block of the following diameter without breaking into two or more pieces.

Power blades, all hard	15 in. diameter
Hand frame blades, all hard	7 in. diameter
Hand frame blades, flexible	2 in. diameter

4. Torsion test

One end of a blade will be gripped in a vise for a distance of one inch and the other end will be rotated evenly, 10 in. between grips—to the extent noted below, held there for one minute and released. The blade must not break into two or more pieces.

Power blades, all hard	60 deg.
Hand frame blades, all hard	180 deg.
Hand frame blades, flexible	270 deg.

5. Cutting test

(a) *Saw and speed*—The test will be made upon a power saw with a six inch stroke, at a speed of sixty strokes per minute, using cutting compound or cutting oil diluted in proportions of ten volumes of water to one of cutting compound or cutting oil.

(b) *Standard bar*—The test shall consist of cuts through a 1¾ in. square steel bar, 65 per cent to 75 per cent carbon, annealed,—Hardness approximately 200 Brinell.

(c) *Pressure*—The total pressure of the blade upon the steel bar at the middle of the stroke shall be as follows:

Power blades .....60 lb. during first thirty strokes, easing the load during the first few strokes—90 lb. subsequently.
Hand frame blades...20 lb. throughout, easing the load during the first few strokes.

(1) *Power blades*—Five cuts shall be made through the bar under the above conditions within the limits specified below, and the time for the fifth cut shall not exceed that of the first by more than 20 per cent.

Teeth per in.	Actual cutting time, maximum
8 to 11	25 min.
12 to 15	28 min.

(2) *Hand frame blades*—(both all hard and flexible.)

Teeth per in.	No. of cuts through standard bar	Size	Maximum cutting time in minutes	Increased time of last cut over that of first cut—maximum, per cent
(a) 10 to 14 incl.	5	.....	52	10
(b) 15 to 19 incl.	4	9/16 in. by .023 in.	46	5
(b) 15 to 19 incl.	4	5/8 in. by .028 in.	52	5
(c) 20 to 25 incl.	3	.....	45	5

At the end of each test the blade must be in good working order.

6. Duplicate tests

If a blade fails on any of the above tests, two additional blades will be taken from the same package, and if either of these fails in any respect, the lot represented will be rejected.

7. Packing and marking

Hack saw blades shall be delivered in bundles containing not more than one dozen blades and labeled with the maker's name or trade mark and the size of the blades. Each blade must also be stamped legibly with the maker's name.

8. Inspection

Inspection will be made at destination. Samples from each size in each shipment will be taken for test and material which is not of uniform quality and in acordance with these specifications will be rejected, the shipper paying the freight both ways.

Device for shortening drawbars

By T. E. House

Blacksmith foreman, Illinois Central, Jackson, Tenn.

THE usual method of shortening drawbars by using a ram or dropping them on their ends, has a tendency to shorten the life of the drawbar. The device used for shortening drawbars, shown in the drawing, eliminates the use of four or five helpers.

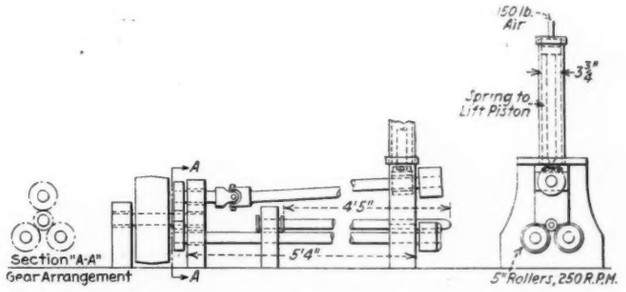
The device consists of two plates, each containing twelve 2 9/16 in. holes for the purpose of adjusting the pin for the different lengths of bars. A collar is placed on the steam hammer of sufficient size to permit the keys, style *A* or style *B*, shown in the illustration, to be driven through the holes. The style *B* key is used when the drawbar hole overlaps the holes in the plates too much for the style *A* key to enter. By using the two keys, a drawbar can be shortened approximately 2¼ in.

A drawbar should be shortened more than required in order that it can be drawn to the proper length. This will leave the drawbar in the best possible condition.

The device can be applied to the drawbar and placed under the steam hammer within one minute after heating. One mechanic and two helpers can apply the device and shorten a drawbar from 1 in. to 2½ in. in four minutes.

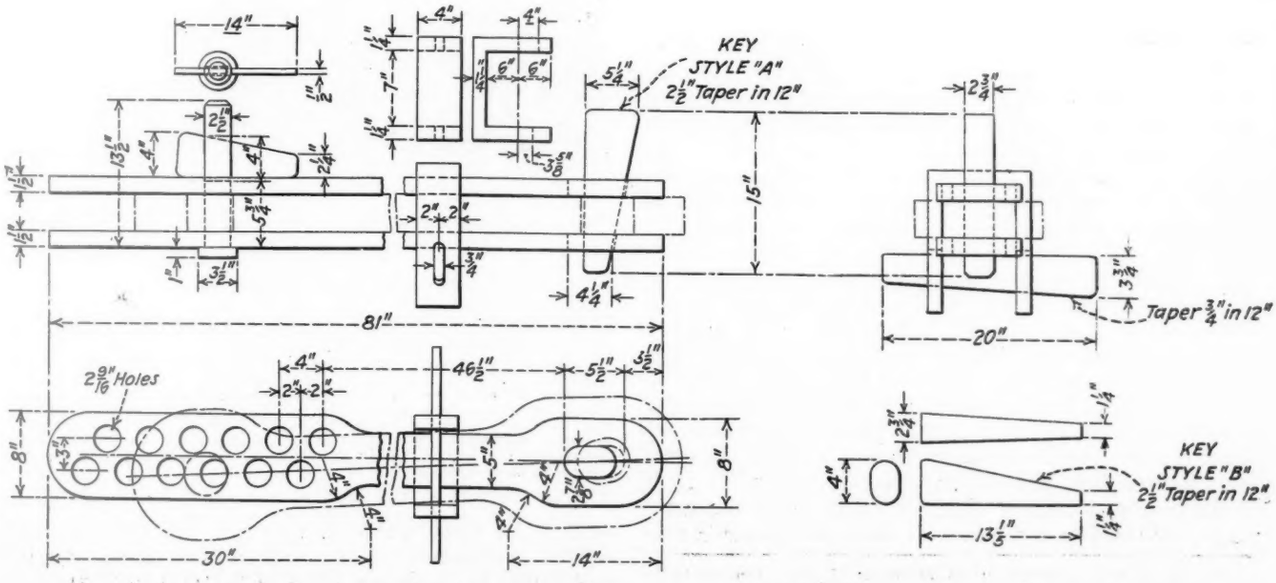
Flue roller used by the Lehigh Valley

THE flue roller, the construction of which is shown in the sketch, was built in the Sayre shops of the Lehigh Valley, Sayre, Pa. The rollers are 5 in. in diameter and run at 250 r.p.m. Pressure for the top roller is received from the shop air line through a booster pump. The top roller is raised by means of a spring under the piston.



Sketch of flue roller built in the shops of the Lehigh Valley

ATCHISON, TOPEKA & SANTA FE.—Plans have been prepared for the construction of a locomotive repair shop, blacksmith shop, storehouse, office building and trackage facilities at Phoenix, Ariz.



With the aid of this device a drawbar can be shortened 2½ in. in four minutes

Tool steel failures—Their causes and cures*

Users of tool steel rarely obtain the maximum service possible from the steels they purchase

By Frank B. Lounsberry
Vice-president, Atlas Steel Corporation, Dunkirk, N. Y.

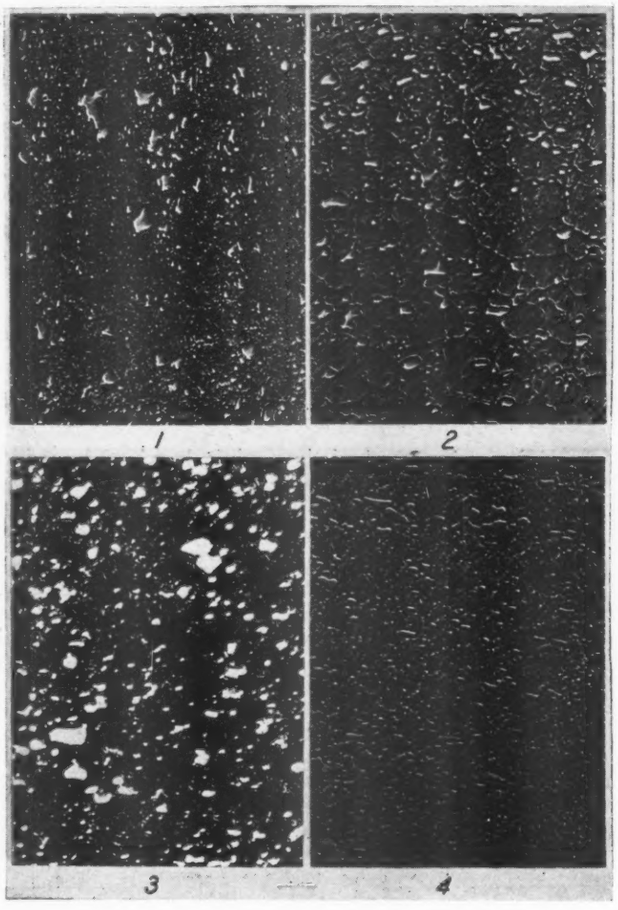
THE practical side of metallurgy which deals with its manufacture and its subsequent use is one that always can be discussed to advantage, the results of which can be checked up and confirmed at any time by experimentation and experience. It is in this connection that we desire to bring to attention certain things which may enable us better to select tool steels and after selection, obtain more satisfactory results from them. Despite improvements in equipment and advances which have been made in heat treatment of all steels, it is rarely the case that tool steel users obtain the maximum service possible from the steels they purchase.

During the course of a year's regular laboratory routine in the mill with which the writer is associated there are normally 400 to 500 complaints to handle. These complaints are all recorded, carefully analyzed and classified. This accumulation after many years gives a fairly accurate estimate not only of mill faults, but also of those most frequently encountered by the user. We have long made it a practice when a complaint is made by a customer to investigate the matter immediately regardless of whether the complaint comes from a large or small user. If the complaint is made to the mill we either send some one directly, or refer it back to the district in which it originated, for attention. Frequently by prompt action the district salesman or manager can correct the difficulty immediately and no further attention by the mill is required. More often, however, in order to arrive at a clear and definite understanding of what the difficulty is, the salesman secures samples of the product complained of and sends them to the mill with complete data for a laboratory report. These are the types of complaints with which this paper deals.

Careful analysis of complaints results in better steel

The complaint as received is given a number and goes to the laboratory for complete physical and chemical examination. This involves chemical analysis, hardness tests, fracture tests, micrographic and macrographic examination, as well as specific tests, depending upon the nature of the case. A complete report is prepared and submitted for consideration. Inasmuch as most complaints are apt to involve adjustment of some sort, it is necessary first to decide impartially whether or not the complaint is justified, and whether the difficulty is due to the mill or to the customer's handling. This decision is sometimes in error, but always it is based on our experience and the facts which the laboratory is able to establish. Only insofar as we are able to interpret the facts intelligently and to correct or improve the conditions found can we hope to improve the steel. This forms the basis for the first general classification, the mill's fault or the customer's fault. We find that of all the complaints recorded over a period of years for whatever reason, in 55 per cent of the cases the mill is at fault and in 32 per cent of the cases the cause lies with the user. The balance, or 13 per cent, are special cases.

In order not to create a wrong impression as to the amount of steel involved, may we say that the total weight complained of per year is only about 100,000 to 120,000 lb., having a value of $20,000 to $25,000. of



Three examples of proper heat treatment and one example of underheating

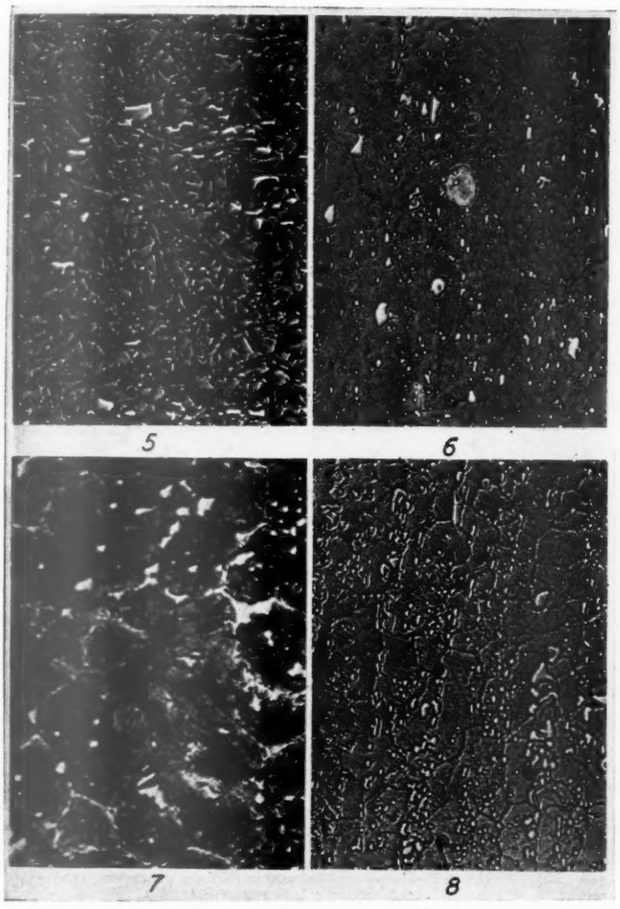
Fig. 1—High speed steel properly annealed showing a uniform carbide distribution—Brinell hardness of 212-228. Fig. 2—High speed steel properly hardened at 2,350 deg. F. in oil—not tempered. This shows the typical polyhedral structure of austenite with well-defined boundaries and uniformly distributed carbides. Rockwell hardness about 62-64 C. Fig. 3—High speed steel properly hardened and tempered at 2,350 deg. F. oil—1,100 deg. F. for 2 hrs. This shows practically complete conversion of austenite to martensite, complete disappearance of grain boundaries and a state of maximum hardness and cutting ability. Hardness about 64-65 C. Fig. 4—High speed steel under-heating. Carbides not in solution and austenite incompletely formed. Such a structure will show as quenched approximately Rockwell 58-60 C. hardness, but will not stand a high temper or show good cutting efficiency.

*Abstract of paper presented at the November 15, 1926, meeting of the New York Chapter of the American Society for Steel Treating.

which the majority is recovered or salvaged in one way or another.

Complaints due to faulty manufacture

Since in the greater number of cases the steel mill is at fault we will analyze these first. Of the 55 per cent listed as the mill's fault, 24 per cent fall in the class headed by inspectors' errors, such as size and shape, pipe, seams, laps, bark or decarburization, pits, marks and other surface defects; 17½ per cent fall under internal



Results of overheating and insufficient tempering

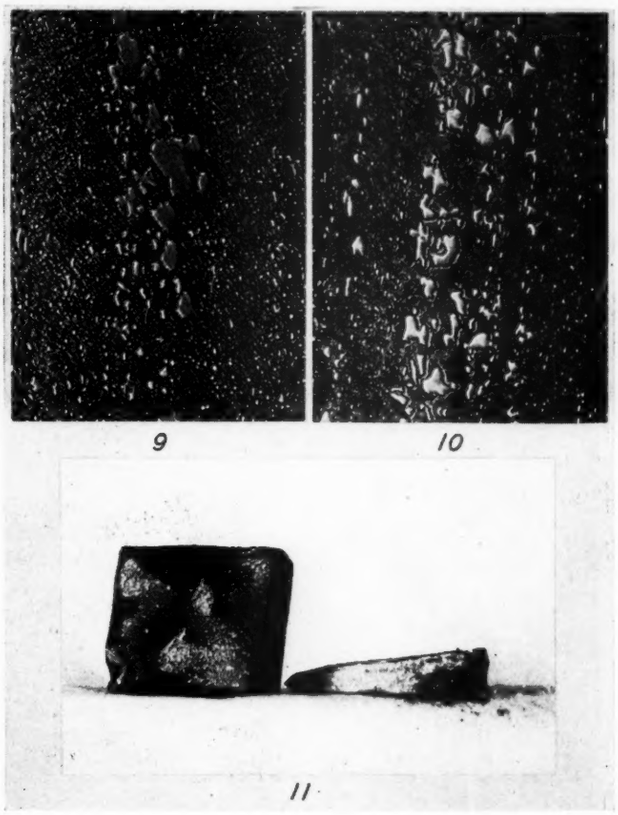
Fig. 5—High speed steel—Example of mild overheating and insufficient temper. Austenite and large martensitic needles. Taken from an end-mill which failed by breaking out. This type of structure is very brittle and liable to grinding cracks. Fig. 6—High speed steel—Considerably overheated and soaking too long at temperature with little or no temper. Magnification, 500 times. Taken from a cut-off tool that failed in service after a short time. Note the large grains of austenite and few remaining undissolved carbides. This represents a very brittle type of structure—Treatment approximately 2,400 deg. F.—Oil and 500 deg. F. temper. Fig. 7—High speed steel—Badly overheated in hardening—Slight fusion started. Magnification, 500 times. Note absence of carbides. Dark areas indicate where fusion has started to take place. Extremely brittle. Taken from the point of a twist drill that failed in test. Fig. 8—High speed steel—Example of insufficient tempering—Taken from an end-mill that broke in service. Similar to Fig. 2.

conditions such as internal seams, secondary pipe, slag or oxide inclusions, segregation of all kinds and microstructure; 8 per cent fall under annealing or heat treatment, which includes wrong hardness due to annealing resulting in poor machinability, or hardening losses due to poor annealing, also improper heat treatment on the part of the mill; 5 per cent are due to wrong analysis or grade, which includes cases where the wrong grade has been applied on our part, or through an error in manufacturing, a wrong analysis has been shipped, such as carbon for high speed, or oil hardening for water hardening. The 13 per cent which is listed as special include cases of wrong size or grade ordered, due to clerical errors, etc., and cases where responsibility cannot be definitely determined.

Faulty heat treatment by user causes much difficulty

Of the 32 per cent listed as customers' faults, the majority of the cases fall under the heading of heat treatment, amounting to 22½ per cent. Three per cent are cases of wrong application or analysis for the use intended. Two and one-half per cent are due to forging or machining strains. One per cent are due to faulty design or mechanical trouble. One per cent are due to improper grinding, resulting in cracks, and the balance are unclassified reasons too isolated to warrant grouping.

From the foregoing it is quite evident that what is required most, from the steel maker's standpoint, is greater care in inspection and closer control in his melting operations. Despite the fact that approximately one-quarter of all the employees in a tool steel plant are engaged in some sort of inspection or control work, still 25 per cent of all tool steel failures are due to the things they miss. As stated above most defects of this kind, such as pipes, decarburization, seams, etc., are quite evident and should be easily caught. Many large consumers now have definite specifications covering such items as



Examples of two failures of high speed steel and fractures from a failed file cutter and boring tool

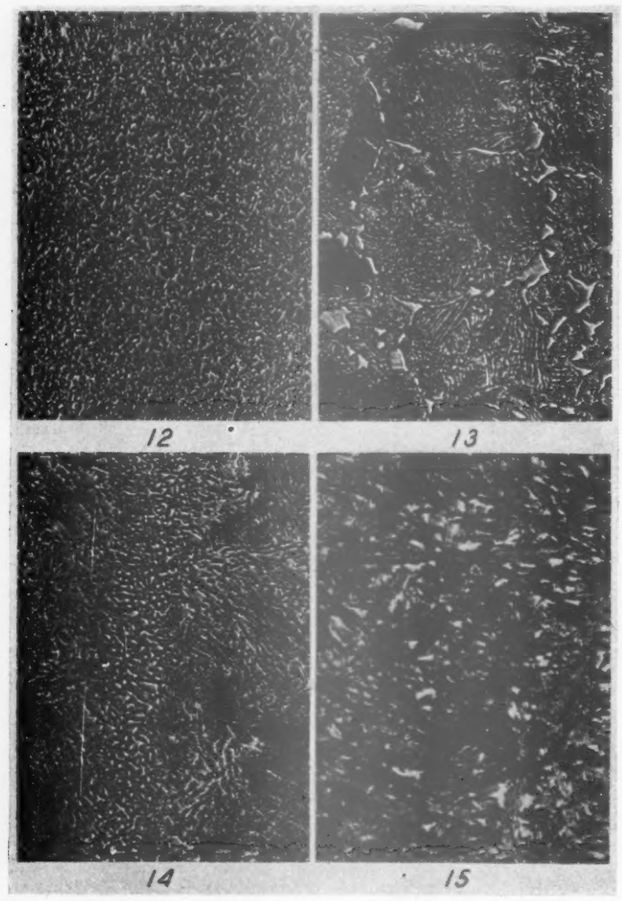
Fig. 9—High speed steel—Carbide segregation in annealed bar. Magnification 500 times. Size of bar approximately 2 in. by 1 in. This is the result of a large cellular structure in the cast ingot which has not been entirely broken up by subsequent working. Always dangerous, causing hardening cracks, crumbling of cutting edges and brittle areas in general. Amount of carbide segregation is dependent upon amount of work put upon the ingot and is almost directly proportional to bar size. Fig. 10—High speed steel—Carbide segregation in a tap made from 1⅜-in. round bar. Shows retained austenite surrounding carbide segregated area. Remainder of structure satisfactory. Magnification 500 times. Fig. 11—Fractures representative of Fig. 6. Small fracture from failed file cutter—Very brittle. Large fracture from boring tool that broke in service. Both of these fractures show what is ordinarily termed a flaky hardened fracture, usually due to one of two causes: repeated hardening without adequate annealing between, or excessive soaking at hardening heat. Both result in an enlarged grain structure (see Fig. 6), and a very brittle condition.

size tolerance, seam depth, depth of decarburization, pits and other surface defects. When intelligently written, these specifications are a great help to the steel manufacturer and eliminate 75 per cent of the possibilities of rejection from these causes. We cannot too strongly recommend the value of chemical and physical specifications when the amount of steel purchased warrants their use, and when the consumer has laboratory facilities for checking and seeing that his specifications are being met.

Many large users buy to their own specifications

Where ten years ago there were practically no specifications covering the purchase of tool steels, today 60 per cent of the large consumers buy according to their own specification and accept all responsibility for the steel once it has passed their inspection and has been approved.

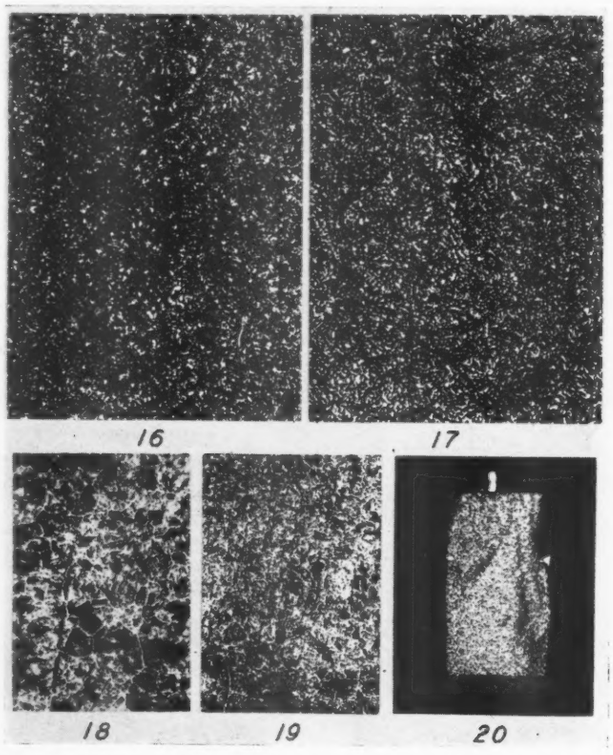
General specifications for all uses are not possible, and in order to obtain best results for any particular requirements, the buyer should consult freely with the steel manufacturer and let him assist in the proper drafting of the requirements.



Some results of poor annealing

Fig. 12—Annealed structure of 1.00 per cent carbon steel showing completely spheroidized condition. Magnification 500 times. Brinell about 160-170. Fig. 13—Poorly annealed 1.20 per cent carbon steel showing lamellar pearlite and traces of grain boundary cementite. Magnification 500 times. Brinell approximately 228. Fig. 14—Poorly annealed oil-hardening non-deforming steel, showing lamellar pearlite and carbide segregation. Magnification 500 times. Fig. 15—Structure shown by Fig. 20—Die of oil-hardening non-deforming steel. Magnification 100 times, showing large martensitic needles.

There is still much to be accomplished by the steel maker in his methods of inspection and his control of operations. The problem of proper heat control from the melting house down through the hammer and mill departments is ever present. It is only when the product arrives at the annealing department that there is any real and accurate temperature control. A certain amount of temperature control is maintained in all of the above mentioned departments, including permanent pyrometer installations on the finishing mill furnaces. Nevertheless there are so many other factors entering into the heating problem that results are bound to show considerable variation. As an example, the variation of 75 to 100 deg. in the finishing temperature on high speed steel is sufficient to throw some bars out of size tolerance and possibly result in seams or cracks if too cold, or burned or cracked edges if too hot. Again, on small sizes a soaking from 15 to 20 minutes overtime in an oxidizing furnace atmosphere will cause excessive bark and scale, resulting in defective material.



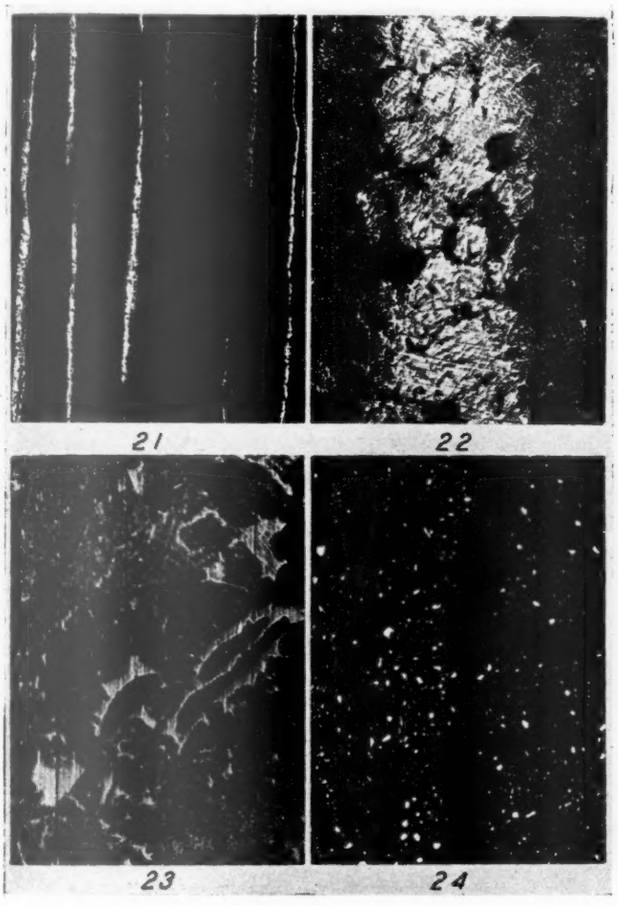
Two examples of properly hardened steel, one of carbon steel, one of abnormal carbon steel, and a fractured die

Fig. 16—Properly hardened structure shown by oil-hardening non-deforming steel. Magnification 500 times. Hardened 1400 deg. F., tempered 375 deg. F. Fig. 17—Properly hardened structure of carbon steel. Magnification 500 times. Approximately 1.00 per cent carbon. Fig. 18—Normal carbon steel—Magnification 100 times. Photomicrograph of case of 0.85 per cent carbon steel carburized three hours at 1,800 deg. F. Ehn test. Fig. 19—Abnormal carbon steel, magnification 100 times. Photomicrograph of case of 0.85 per cent carbon steel carburized three hours at 1,800 deg. F. Ehn test. Fig. 20—Fracture of die of oil-hardening non-deforming steel which broke in service. It showed an overheated condition.

A second large consideration from the steel maker's standpoint is more control in the melting operations. It is a common saying in the steel mill that when trouble shows up anywhere it usually is traced back to the melting house. This, of course, is not literally true, but is true to an extent that if every ingot turned out were 100 per cent perfect, the majority of the steel maker's perplexing problems would be removed. Many of the illustrations which accompany this paper show certain defects which are directly the result of improper melting and subsequent operations. The electric melting furnace has been a big aid to the tool steel manufacturer in helping him to obtain better control over his operations, both from a chemical and a thermal standpoint.

Heat treatment of tool steel

Regarding tool makers' troubles, or as we term it, customers' fault, the greatest variable is that of heat treatment. Improper heat treatment accounts for 70 per cent of all troubles the tool maker has in his own shop. The failures due to faulty design, machining difficulties, wrong application, etc., can almost be ignored, as can also grinding and its subsequent losses. Under this factor of heat treatment, perhaps the main causes of trouble may be summarized as due to four principal errors: (1) rapid heating; (2) over heating; (3) furnace atmosphere conditions; (4) improper tempering.



Three specimens of chromium-molybdenum bearing steel and an example of oxide inclusions in hardened chromium bearing steel

Fig. 21—Banded structure shown by chromium-molybdenum bearing steel, not annealed—Size 1 7/8 in. round. Magnification approximately 50 times. Bands are ferrite segregation. Fig. 22—Ferrite segregation in chromium-molybdenum bearing steel. Magnification 500 times. Photomicrograph of one of bands shown in Fig. 21. Fig. 23—Slag inclusions surrounded by ferrite. Taken from tensile test piece from forging of chromium-molybdenum steel which did not meet physical specification. Magnification 500 times. Fig. 24—Oxide inclusions in hardened chromium bearing steel. Magnification 500 times.

Rapid heating—This practice usually results in non-uniform and abnormal strains, causing cracks, deformation and uneven hardening.

Overheating—This usually results in burned edges and points, enlarged grain size with resultant brittleness and cracking and abnormal changes in size and shape.

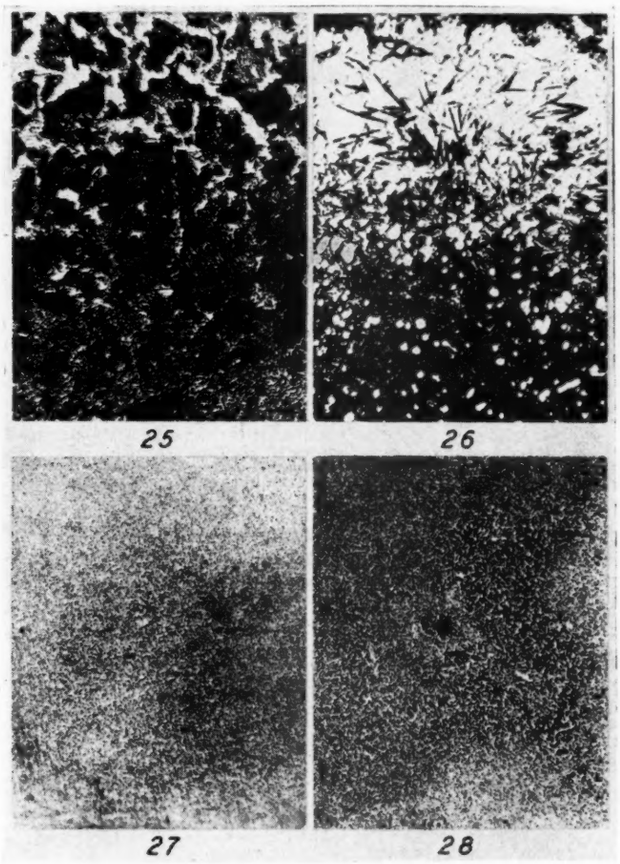
Lack of control over furnace atmospheric conditions—This usually results in decarburization and soft tools, and in blistered, burned and scaly surfaces, resulting in loss of size and shape.

Improper tempering—This error, especially in high speed steel, accounts for more failures than any of the others. Insufficient and improper tempering results in cracking, brittleness, poor cutting ability, deformation and, indirectly, in many other troubles. One expression which may cover heat treatment difficulties is "lack of control."

Principal causes of tool steel failures

The writer has covered in some detail the principal causes of tool steel failures, and also has suggested some cures for individual types of failures, emphasizing two factors which will tend to eliminate most difficulties; namely, greater control and co-operation.

Under the first, greater control, we should, however, obtain the very best and most modern equipment available commensurate with our means and then see to it that it is properly used, remembering that a fine furnace and an accurate pyrometer alone does not necessarily turn out perfect tools. They must always be intelligently used to aid the operator who, after all, is the one held responsible for the results. So often no expense is too great for proper engineering and machine operations but any old kind of a set-up is good enough for the hardening room. This is not as prevalent today as it was five or ten years ago, thanks to the American Society for Steel Treating and its educational program, but it still exists in many plants.



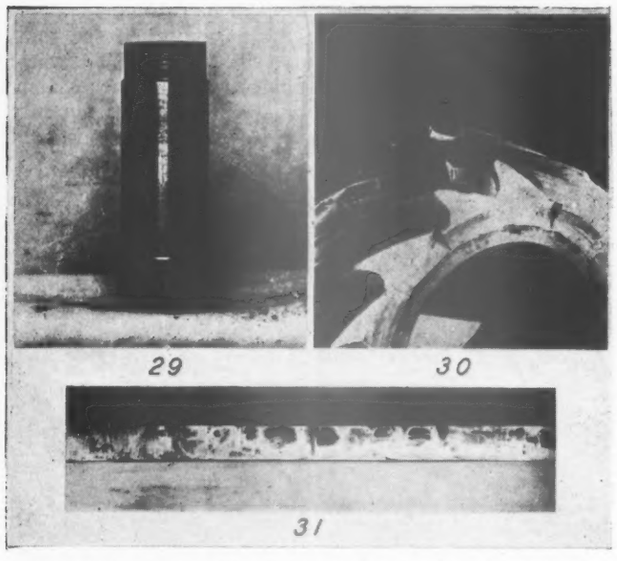
Two examples of decarburization and the results of etching a specimen of chromium-molybdenum steel

Fig. 25—Decarburization shown by approximately 1.00 per cent carbon steel—Annealed condition. Total depth approximately 0.030 in. Ferrite zone approximately 0.015 in. Magnification 125 times. Fig. 26—Decarburization shown on small high speed drill, as result of oxidizing furnace conditions in hardening. Magnification 500 times. Fig. 27—Deep-etch test on cross section of 3/4-in. square chromium-molybdenum steel showing uniform condition. Etching time approximately 1/2 hr. in 1:1 hot hydrochloric acid. Fig. 28—Deep-etch test on similar section to Fig. 27 showing non-uniform condition largely the result of ferrite segregation.

As a further suggestion, it should be the endeavor to

keep accurate records of the heat treatments given and to work out a standardized schedule for time and temperature covering each type and size of tool. The performance of tools should be followed up in order to learn when best results are obtained and especially failures should be run down for the purpose of learning definitely their cause so that in the future they can be avoided. Work out specifications covering the several types of tool steels necessary for requirements and work out the heat treatments wherever possible.

Regarding the second general heading, co-operation, may we suggest greater co-operation between the tool



Cracks in Figs. 30 and 31 are the results of grinding

Fig. 29—Step-down test on chromium-vanadium bar stock showing internal seams. Fig. 30—High speed milling cutter showing grinding cracks. Fig. 31—Shear blade of high speed steel showing cracks which were the result of grinding.

maker and the tool steel manufacturer. Submit your problems to him and consult him freely and frequently. It has been the writer's experience that many apparently impossible things have been corrected and improved by working closely together with a customer and always with mutual benefit. In the matter of correct application, the tool steel maker can be of utmost assistance to the user, but first he must be given all the facts and details. Getting a proposition started off right is 50 per cent of the accomplishment.

Machining bushings for piston valves

By W. A. Pownall,
Mechanical engineer, Wabash, Decatur, Ill.

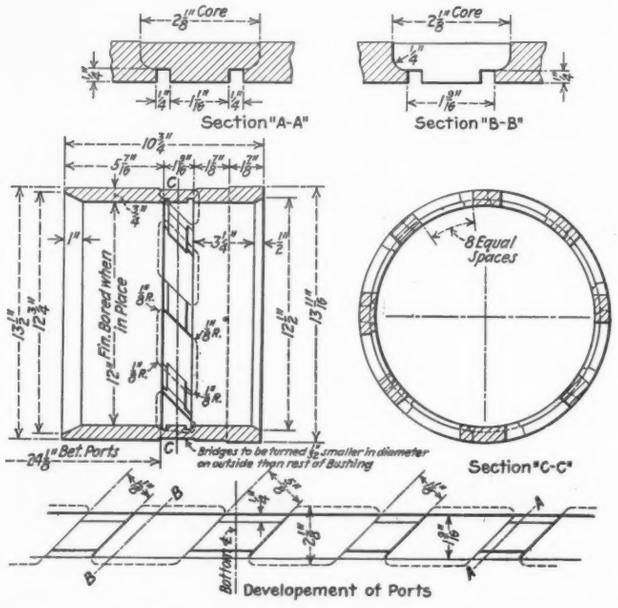
A METHOD of machining the ports of piston valve bushings is used on the Wabash which results in some labor saving over the ordinary methods.

The usual piston valve bushing has the ports milled straight through whereas the new method uses a diagonal cast port, as illustrated, with the admission and exhaust edges only, machined.

The object of this procedure is primarily to reduce the time and therefore labor cost in the machining of piston valve bushings and also to get a good clear-cut steam port opening. This method of machining could be used on the straight ported bushing, but the diagonal ports give greater area through the bridge, thus increasing the strength as well as the lateral wearing area over the bridges. This prolongs the life of the bushing, and also gives wider wearing area on the rings which is of particular advantage when the valve is operating on short cut-off.

The method of machining the straight ported valve bushings consists of boring and turning, and laying off the ports inside the bushing, which would ordinarily take about 1 hr. 20 min. Bushings are then cut off, sent to the milling machine, and the ports milled, which consumes perhaps 45 minutes. The ports are then chipped and filed square on the steam admission side in the corners where the milling tool has left a radius, this taking about 30 minutes, and making the total time for the operation 2 hr. 35 min.

With the diagonal port bushing, the bushing is first bored and turned to the proper inside and outside diameters. Two grooves ⅛ in. wide and ⅛ in. deep are then turned for the full inside circumference of the bushing, the edges of the grooves being so located as to give the



Method of coring valve chamber bushing ports so that they may be machined without resetting, in the boring mill

proper width of port opening. This gives a sharp edge, both for the admission and for the exhaust sides, as is clearly indicated from the illustration. Any small fins left in the ports are quickly knocked out with a hammer and chisel. The bushings are cut off, and are ready to apply. All of the work is done on the boring mill, and the total time is only 1 hr. 30 min. as compared with 2 hr. 35 min. for the old method with the straight ported bushing.

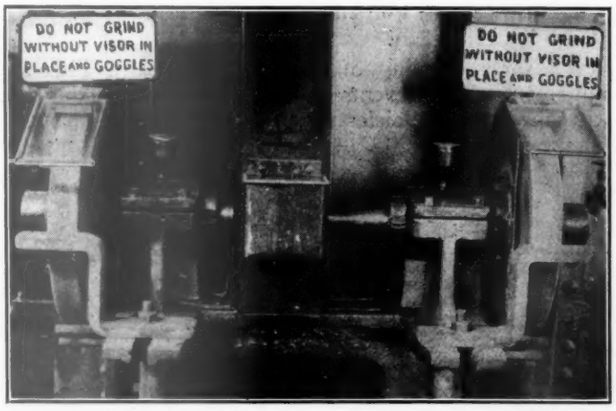
TAPERED ROLLER BEARINGS.—Reprints in illustrated booklet form of the paper on "Recent Developments in the Application of Tapered Roller Bearings in Machine Tools" may be had by addressing the Industrial Equipment Division of The Timken Roller Bearing Company, Canton, Ohio. This paper was presented by S. M. Weckstein, Industrial Equipment Engineer of The Timken Company at the Machine Tool Section of the A. S. M. E., held in connection with the New Haven Machine Tool Exposition in September. It covers in a comprehensive way the results of recent important developments in the use of tapered roller bearings in various types of machine tool equipment, many of which are adequately illustrated.

Two simple kinks for the machine shop

By J. R. Phelps
Apprentice instructor, A. T. & S. F., San Bernardino, Cal.

QUITE often we are apt to overlook little things that might help in the work of production in the search for the larger or seemingly more important. For example, it only takes a short time for cast iron shavings and dust to sift down in the jaws of a chuck and commence cutting the screws which will eventually make them turn harder and sometimes clog up, an eventuality which is usually overlooked until it occurs. Shown in one of the illustrations is the chuck of a boring mill used for turning cast iron bull rings, the jaws of which

The jaws of a chuck will operate easier and the screws last longer if protected from dust and chips



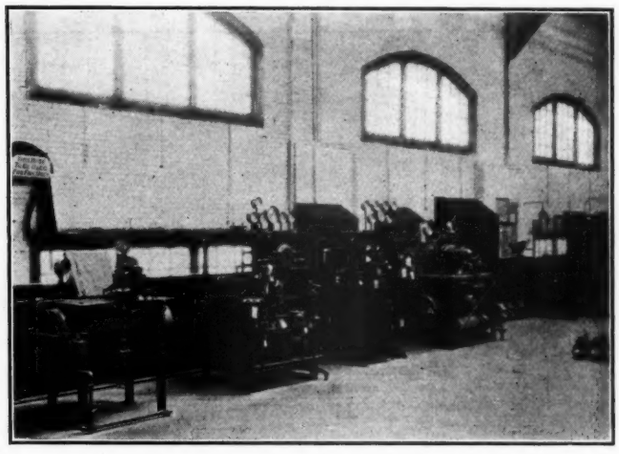
Handy water can of substantial construction bolted to the belt cover of an emery wheel

are covered with pieces of scrap leather secured from the upholstering shop in the car department to keep the dust and shavings out of the jaws. Holes are cut in the leather to allow the top of the jaw to stick through in order to hold the cover in place.

There are many instances where the water can at an emery wheel is some battered old bucket, setting on the floor and only half full of water. Sometimes the pail has been taken to another part of the shop to serve as a container for bolts or nuts. An arrangement, similar to that shown in the illustration, which is a permanent water can, bolted in place at a convenient height for a man to reach it while grinding, will help to improve the looks of the shop and improve the disposition of the man using the grinder. It is much easier, when cooling a tool to reach over to the water can, bolted in place, than it is to look around for a bucket on the floor.

A well organized air room

WITH a roomy, modern, well-lighted and well-equipped air room, the Union Pacific locomotive shops at Portland, Ore., are particularly well adapted to overhaul and repair the large amount of air brake apparatus removed from equipment at Portland shops and that which is received from outside points. With six mechanics and two apprentices, the following is the average monthly output: 25 air compressors, 350 triple valves, 30 brake valves, 100 feed valves, 10 control valves, 20 distributing valves, and 20 air compressor governors.



The arrangement of test racks

Two mechanics and one apprentice work on triple valves; one mechanic works on brake valves, governors, train control valves and testing locomotives; one mechanic works on feed valves, distributing valves, signal valves, etc.; two mechanics and one apprentice work on air compressors.

The triple valve repair benches

The air room is located on the mezzanine floor of the

machine shop and occupies a floor space of 51 ft. by 63 ft. Cramped quarters do not make for efficiency, as workmen are constantly getting in each other's way which cuts down the output. The first impression on entering the Portland shop air room is one of roominess. The second is good light. Obviously for effective work, particularly in repairing the more or less intricate parts of air brake equipment, the best light available should be provided. Daylight is admitted to this air room from the north and therefore varies but little from sunrise to sunset. For work on cloudy days, the best of artificial light is provided by a number of drop lights in addition to which, individual socket lights are available where necessary.

Other decidedly noticeable features of the air room are the orderly arrangement of work benches, test racks and other equipment, and the care which is evidently taken to keep the floor clean. The elimination of boxes, lockers and sundry dark corners does much to prevent the accumulation of a large amount of miscellaneous material of little value and practically forces the keeping of usable repair material and parts where they will be easily seen and available when needed.

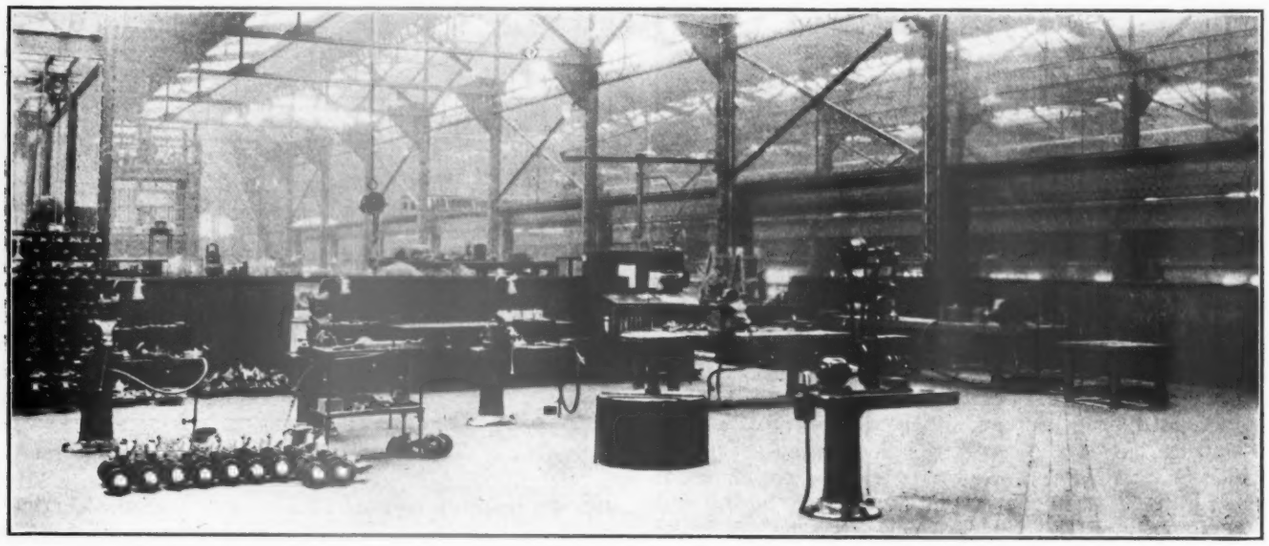
The equipment of this air room consists of work benches and test racks, a power-driven lapping plate and a small sensitive motor-driven drill. The work benches, at which the various types of valves are repaired, are unusual in that they are made of cast iron and mounted on a small but substantial cast iron column, firmly secured to the floor by four bolts. Each bench is provided with a large vise, drawer, an adjustable electric light, and a short section of air hose with blower tip and valve on the free end for blowing out valves, ports, etc.

The power lapping plate for facing small valves, such as triple valves and slide valves, is located near the center of the room to be conveniently accessible to all work benches. The lapping plate is driven from the main shaft under the mezzanine floor. The use of No. 90 abrasive on the plate has been found by experience to give the most satisfactory results as it leaves the plate in condition to wear slide valves down at the proper rate. Slide valve seats are trued with a special file. Rings are fitted to the ring grooves by lapping on one side only and filing the ring opening until a proper fit is obtained in the cylinder bushing.

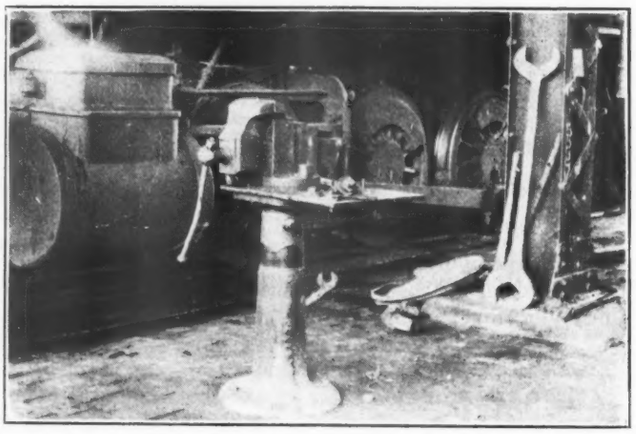
Aside from the lapping plate, power lapping and grinding machines are not used. Triple valve cylinders are trued by means of expansion hand reamers which leave the cylinders sufficiently smooth and accurate so that little lapping is necessary. The time consumed in the combined operation of reaming a cylinder bushing and fitting the ring is about 12 min. for reaming and 3 min. for fitting.

The small motor-driven drill, shown in the general view of the room, being in close proximity to the repair benches saves considerable time which would otherwise be required to carry parts to the machine shop, have them drilled and then returned.

The placing or grouping of test racks together, centralizes installation and cuts the cost. Furthermore, by grouping all outgoing material that has been tested, extra handling is avoided and floor space conserved One portion of floor, protected by floor markers, is reserved for the piling of outgoing material. This arrangement also prevents confusion and facilitates the provision of safety aisles which are maintained throughout the shop.



General view of the air room at the Union Pacific Shops, Portland, Ore.



One of a number of vise stands with swiveling feature and auxiliary trays which saves many steps in the Union Pacific enginehouse, Cheyenne, Wyo.

Electrically driven rolls save labor in valve setting

POWER-OPERATED devices have been used in some railroad shops for a number of years for rolling locomotive main driving wheels when setting valves, with a saving in labor over the old ratchet bar arrangement operated by hand. The Illinois Central uses a portable electric motor driven unit for furnishing power to valve setting rolls in its locomotive repair shop at Waterloo, Iowa, this electric machine replacing an air-operated device which was discarded because it lacked the necessary power, speed and flexibility of operation.

Motor driven valve setting rolls in use at the Illinois Central shops, Waterloo, Iowa

The present machine, driven by a 7½-hp., 440-volt, slip ring, induction motor, has a reversing drum-type controller and can turn the largest driving wheels through a complete revolution in one minute and five seconds. The finest adjustments of the driving wheel position can be made readily, and the reversing drum controller permits changing the direction of rotation instantly. After the device is connected to the rolls, the valves can be run over in about 40 min., it being possible to run over, adjust and check valve motion on three engines a day.

With the pneumatic machine formerly used at the Waterloo shops, valve setting operations required two hours' time after the device was attached. The time saving is substantial, as the present electrical machine permits doing the job in 40 min., or one-third of this time.

Power from the motor is transmitted through a double spur and worm gear reduction connected by the customary shaft and two universal joints to the driving wheel rolls. Proper rigidity of the power unit is obtained by means of two "lazy legs" which, when turned down, rest on the floor and support the truck frame, the wheels at the same time being blocked, front and back. This is essential, as the load on the device is heavy and the torque sufficient to induce an overturning moment which causes the truck to vibrate and jump around if not securely blocked. The 6-in. hardened steel rolls under the driving wheels are grooved, to provide greater frictional adhesion when rotating the wheels. A 100-ft. cord with a fourth conductor for grounding the frame is provided and carried, when not in use, on a hook on the side of the machine. The conduit on the shaft is grounded, and all portable electrical machines at Waterloo shops are equipped with grounded cords 100 ft. long to protect operators against accident.

In operation, the rolls are placed under the main locomotive driving wheels and the portable motor-driven power unit connected through the substantial shaft and two universal joints. The driving axle and wheels are jacked up to their normal operating position with respect to the frames, the rolls then being pulled tight against the wheels by means of nuts on the long screws. This holds the wheels at the proper elevation above the rails and enables them to be turned during the valve-setting operation. Careful attention to securing proper elevation of the driving wheels enables the valves to be set under exactly the same conditions as obtain when the locomotive is operating, and this promotes better functioning of the valves in road service and, hence, greater fuel economy. The 7½-hp. motor has proved ample in power to turn the wheels under the most difficult conditions.

After the valves are properly set to give the correct steam distribution, the work can be "proved" quickly by turning the wheels through a complete revolution with the valve in full gear, forward and back, and again with the reverse lever "hooked up." The valve setter's work can, therefore, be checked in very little additional time because of the effectiveness of the electric power-driven rolls. These power-driven valve setting rolls were developed by Norman Bell, master mechanic, Illinois Central, Waterloo, Iowa.

The 7½-hp. electric motor and substantial gear reduction, enclosed in a covered sheet metal box, are mounted on a four-wheel truck for easy movement about the shop

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FOURTEEN APPOINTMENTS for graduate assistantships in research work in the Engineering Experiment Station at the University of Illinois, Urbana, Ill., are available for mechanical engineering graduates of approved American or foreign universities and technical schools. Appointments to the position of research graduate assistant are made and must be accepted for two consecutive collegiate years of ten months each. At the expiration of this period, if all requirements have been met, the degree of master of science will be conferred. These assistantships pay an annual salary of $600, together with freedom from all fees, except the matriculation and diploma fees. Preference will be given to those applicants who have had some practical engineering experience following the completion of their undergraduate work. Appointments are made in the spring and they become effective the first day of the following September. Additional information relative to these appointments may be obtained by writing the Director, Engineering Experiment Station, University of Illinois.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Setting safety valves—A question

PORT ARTHUR, Ont.

TO THE EDITOR:

When a locomotive safety valve has been completely dismantled or old parts replaced with new, is there any method by which the valve can be set approximately correct before it is returned to the boiler? I have been told that it is possible to obtain an approximate setting by screwing down the adjusting screw until a certain number of threads project. This method, however, will not apply to all types of safety valves.

I would like to have some suggestions as to any better method for obtaining such an approximate setting of a safety valve.

F. O. ROBINSON.

Spokes breaking on main driving wheels

DENVER, Col.

TO THE EDITOR:

We are having considerable trouble due to the breaking of the short spokes between the hub and the counterbalance of the driving wheels on our passenger locomotives. Do any of the readers of the *Railway Mechanical Engineer* know what causes this difficulty and how it can be prevented?

J. E. PURCELL.

Shearing stress in passenger car side girders

ST. LOUIS, Mo.

TO THE EDITOR:

An article by Wendel J. Meyer entitled "Shearing stress in passenger car side girders" was published in the October, 1924, issue of the *Railway Mechanical Engineer*, page 604. Mr. Meyer in this article explains the

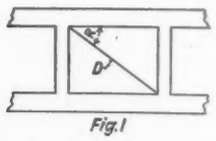


Fig. 1

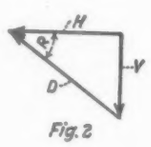


Fig. 2

action of vertical and horizontal shear which I believe is incorrect but, on the other hand, I find several mechanical engineers who believe his explanation to be the correct one.

Referring to Fig. 1 of the sketch which shows a diagonal brace applied to a window opening in the side of a passenger car, if the upper and lower chords were pin-connected at the ends, the diagonal shown would be necessary. However, the vertical component of the force transmitted by the diagonal would not itself tend to flex the upper and lower chords in a vertical direction, as shown by the vertical component V in Fig. 2. The vertical component V, it will be observed, is also a function of the horizontal shear H.

As no diagonal braces are used in passenger car windows, it is obviously wrong to figure the shearing stresses with an additional bending moment as it only means adding unnecessary weight to the car. The vertical force in the post caused by the load is neglected as it is taken care of when figuring the bending moment for the entire girder.

CARL O. KOWAL.

Economic problems in car repairs

LORAIN, Ohio

TO THE EDITOR:

Two editorial comments entitled "An economic problem in car repairs" and "Are you throwing good money away?" were published in the December, 1926, issue of the *Railway Mechanical Engineer*, that are of direct concern to all mechanical department men. Time and again I have seen shop supervisors literally with their backs to the wall in their efforts to increase shop production. They have had to resort in such times of emergency to some scheme of a make-shift character or knock together some kind of a home-made machine which would give increased production until such time as the "powers that be" would come across with a suitable machine or appliance.

The points raised by the American Railway Car Institute can be applied to the locomotive department as well as to the car department. All railroad men will admit that the general policy of the railroads of doing their own repair, rebuilding and building work has been of benefit to them as a class. I can recall, however, the days when a train of defective cars was made up from the shop storage tracks and billed to some contract shop for repairs, when at the same time the car department was working half time and with a reduced force at that. You can imagine the feelings of the men in the shop when such incidents occurred. Do you think that such a policy was of benefit to the company? Do you believe that it aided in producing a satisfied body of employees who would be willing and anxious to go to bat for the company at any time? My experience is, that such a policy does not produce such results.

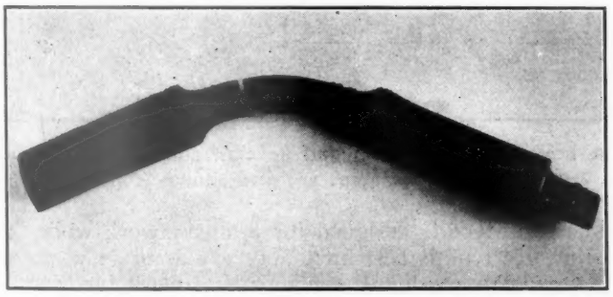
JOSEPH SMITH.

THE DENVER & RIO GRANDE WESTERN has granted shopmen increases in wages ranging from one to two cents an hour.

HYTEMPITE.—Some of the details of construction and maintenance of brick and tile work in power plants are dealt with in a 24-page illustrated bulletin entitled, "Hytempite in the Power Plant," which is being issued by the Quigley Furnace Specialties Company, Inc., 26 Cortlandt street, New York. Emergency repairs and replacements that have been made permanent through the use of Hytempite are also described.

Cast iron alloy developed for grate bars

DURING the past two years the Q & C Company, 90 West street, New York, has been doing considerable development work in an effort to obtain a commercial iron that would not warp or twist under temperatures encountered in locomotive grate service. This experimental work has finally resulted in the development of an alloy cast iron which is being placed on the market under the trade name of Nogroth metal. Nogroth metal is an air furnace product. Its structure resembles that of white cast iron and has many of the properties of cast steel. It has, however, a number of physical properties different from that of cast



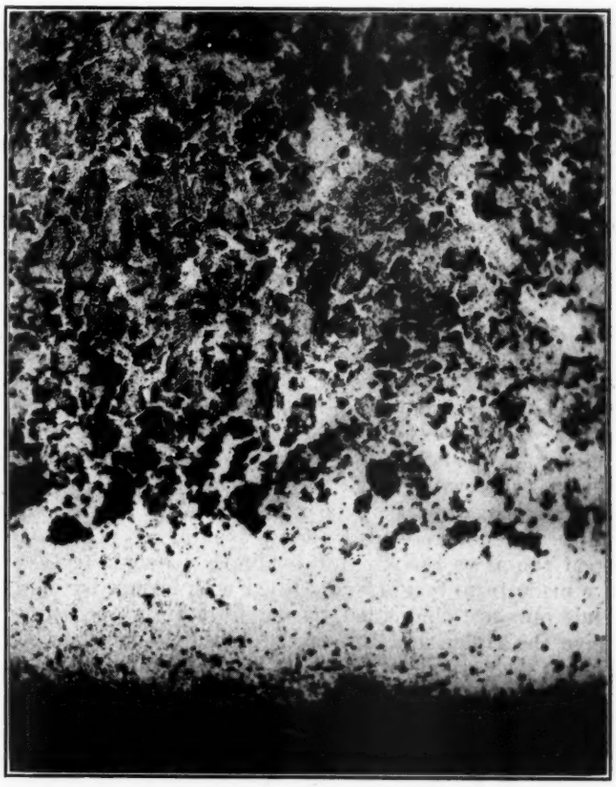
A test bar of Nogroth metal bent to the shape shown before breaking

iron, in that it retains its original strength at high temperatures, nor will it grow when exposed to temperatures below the melting point; that is, the metal will not acquire a permanent expansion when subject to high temperatures.

Results of physical tests made on four specimens of Nogroth metal

Test piece	Test piece: Size	Test piece: Area sq. in.	Yield point: Lb.	Yield point: Lb. per sq. in.	Ultimate strength: Lb.	Ultimate strength: Lb. per sq. in.	Elongation: 2 in.	Elongation: Per cent
No. 1	.614	.2960	10,990	37,120	21,410	72,330	.12	6
No. 2	.613	.2951	11,940	40,460	21,820	73,940	.12	6
No. 3	.612	.2941	11,780	40,050	21,620	73,510	.10	5
No. 4	.614	.2960	11,600	39,180	22,060	74,520	.13	6.5

Four specimens of Nogroth metal from different heats were recently subjected to laboratory physical tests, the results of which are shown in the table. The yield point of this metal is about 40,000 lb. per sq. in. and the ultimate strength is approximately 73,000 lb. The ductility of this metal is indicated by the elongation of 6 per cent in 2 in. shown for three of the four test specimens in the last column of the table. Additional evidence of the ductility of Nogroth metal is shown in the illustration of a test specimen which was placed in a vise and bent cold to the shape shown, before breaking.



Microphotograph showing the structure of a test piece near the surface—A thin layer of ferrite is followed by a thick layer of sorbite steel—Magnification, 100 times

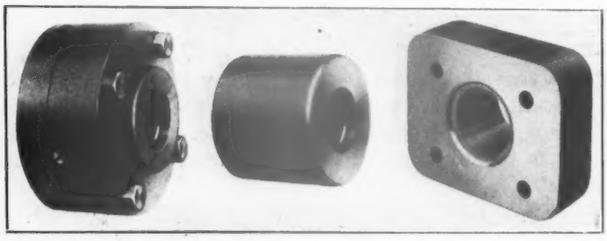
Locomotive parts of Nogroth metal, such as grate bars, are cast in the same manner as when the parts are made of cast iron, except that the Nogroth metal

is heat treated after it has been removed from the mold. By varying the character of the heat treatment, the Brinell hardness may be varied from 200 to somewhat above 550. Parts made of the softer grades of Nogroth metal are easily machined. The tensile strength of unheat treated Nogroth metal is about 50,000 lb. per sq. in., the other physical properties being the same as that of high grade cast iron.

Warner & Swasey turret lathe tools

FOR some time past the Warner & Swasey Company, Cleveland, Ohio, have been developing new tooling equipment of a standard type designed to eliminate the necessity for the user to make special tools. Among the tools of this nature which have recently been brought out are the four described here.

As a convenient means for locating endwise work in a chuck the adjustable chuck back stops have been designed for work requiring close limits of accuracy on shoulder distances for which special chuck jaws would otherwise be necessary. The adjustment provided by

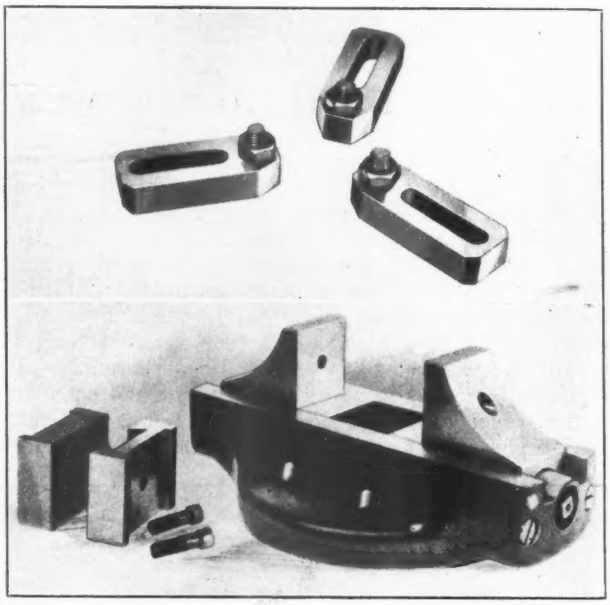


Adjustable (left) and plain (center) adapter hoods and adapter plates (right) for turret lathe work

the stop screws is ordinarily of sufficient accuracy for first operations if it is desired to use them as plain backing screws. However, for second operations, the screw ends are purposely left soft so that a cut may be taken from them to provide extreme accuracy. These back stops are held to the chuck by either tapping into the face or by T-slots and they may be swiveled on the chuck face to locate the screws on varying radii.

For holding work of awkward shapes, where rigidity and accuracy are required, the box chuck has been designed to give more rigid support to the jaws in the body. Small work is considered difficult to chuck accurately without the use of jaws that are fitted to the shape of the work. The box chuck has been found to be well adapted to this type of work because of its coarse pitch and double ended screw, making it possible to open the jaws quickly for loading. The master jaws are made from forgings and fitted with bronze bushings. Half nuts are eliminated, as the jaws are tapped to receive the right- and left-hand screw. Adapters, which fit into the permanent jaws, are provided for holding the work jaws. These are finished in either the blank or dovetail type. The flange of the chuck is recessed for face plates so as to fit the spindle of any machine.

Both plain and adjustable types of adapter hoods are available in The Warner & Swasey Company's line of tooling equipment. There are made in standard sizes to screw on the spindle noses of the different machines and are threaded to fit the various styles of adapters.



A box chuck with plain and dovetail adapters—Adjustable chuck back stops are also shown (top)

The plain type is designed for ordinary work while the adjustable type is best fitted for very accurate work, as it is possible to aline the adapter and work for concentricity, after the work has been placed on the adapter.

Provision has been made for adapting any of this company's line of flanged tools, including the single and multiple cutter turners to the universal hollow hexagon turret lathes through the use of adapter plates. These adapter plates are tapped in such a manner as to make it possible to adapt the smaller tool flanges to the turret faces of the larger machines, the plates varying, however, according to the tool and the size of the machine.

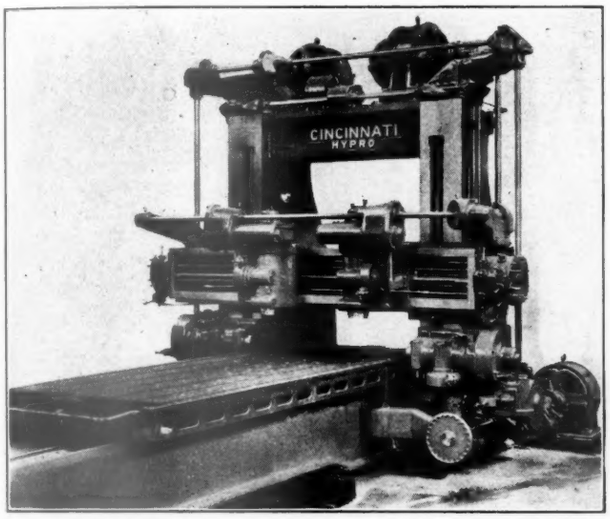
Hypro planer type of milling machine

INDEPENDENT movement of the heads, spindles and table has been embodied in the planer type of milling machine manufactured by the Cincinnati Planer Company, Cincinnati, Ohio. This was done to enable the operator to be feeding one head and rapid traversing the other. The bed and table have forced lubrication supplied to the ways by a pump driven by the same motor that moves the table. The bed is twice as long as the table, eliminating overhang.

The table is of the box type construction which will prevent distortions when setting up large castings. To prevent the table from lifting, a table clamp and an inner guide is supplied. In the bottom of the tee slots, chip slots are cast at intervals to make it easy to clean the

slots. The table end is provided with a special pocket which serves several purposes. First, it will catch chips that fall from the end of the table; second, the pocket is easily cleaned by means of a hole at the sides and third, it provides a means for clamping the work the full length of the table.

The complete train of gears is flooded with oil. The shafts that carries these gears revolve in bearings at the side of the bed and are lubricated by forced feed supplied by the same pump that provides lubrication for the ways. A worm and wheel are placed between these gears



A four-head planer type of milling machine

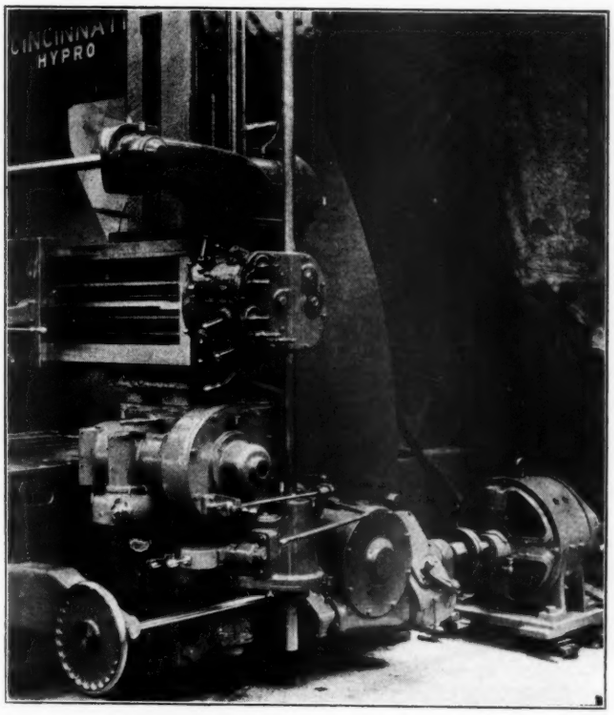
and the four-to-one reversible variable speed motor. There are fifteen different motor speeds and, with the back gear, a total of thirty table speeds. The range on this machine for the cutting speed is from 2 in. to 16 in. per minute; a high speed return is supplied enabling the machine to return at 25 ft. a minute.

The control lever for changing from the cutting speeds to high speed and also neutral is placed convenient to the operator's hand. A hand adjustment is supplied to the table. With this device, it is possible to move the table with ease at the rate of .001 in. This hand wheel is provided with a throw-out clutch so that when operating at high speed, the table hand wheel will not revolve. A graduated scale is placed on the side on the table which gives a direct reading.

The four milling heads are all independent of each other. It is possible to rapid traverse one or all the heads at the same time. One head can be fed while the other is being rapid traversed. The quill on one head can be fed while the other is rapid traversed. All of these movements can be operated from either the right or left side of the machine. In case the operator jams the two heads together or jams the side head against the rail or the cutter against the job, no accident will result. An automatic safety friction is provided. The complete operation of these heads is controlled by two levers. All that is necessary to make one change or the other is to move these two levers. A single lever controls the direction of all heads.

The spindle is driven by a worm and worm gear which runs in oil. The gear is large enough in diameter so that the milling cutter will generally be smaller. The gear is not a locking angle and is provided with two sleeve bearings fitted with roller bearings. A speed box is provided to give two independent speeds to all heads. Two 15-hp. motors are placed on top of the machine—one motor drives the spindle to the two rail heads, the other supplies power to the two side heads. These heads are designed to carry 50 hp. The quills have a vertical adjustment of six inches. The reverse of feed is obtained through a lever on the right hand end of the rail. Necessary binders are provided to the saddle and quill. The rail is provided with a narrow guide to carry the rail heads. This prevents the twisting of the heads and also assists in feeding the head across the rail. The rail has an exceptionally wide face and is provided with extra bearing surface against the uprights.

The rail is clamped by a single turn of the rail clamping device. A square is placed on the end of the rail and with a single turn the rail is clamped securely enough to take any size cut. When loosening the rail, a clutch is moved over, engaging power to the elevating device; when clamping, this clutch is disengaged. This makes it impossible to elevate the rail when partially or totally clamped. For raising and loosening the rail, the same lever that controls the direction of the rapid traverse of the heads is used. In case the rail is high above the table, the rapid traverse lever on the side head can be



The control levers are all conveniently accessible in one location

used. This actually provides four levers for raising and lowering the rail. One motor is used to supply power for moving the rail and rapid traversing the heads. Ball and roller bearings are used throughout in the construction of the machine.

The three motors are controlled by one board. Dials are placed on the cover of this board to give direct motor speed and in reality spindle speeds and feeds. Each motor is supplied with three push buttons, which are so interlocked that it is impossible to feed the table in any direction unless the spindles are revolving. If either of the driving motors should fail the table motor will automatically stop. Push buttons are placed on both sides of the table and a start and a stop button is placed on the control lever. The entire machine is controlled from the operator's position.

Compressed air oil and moisture separator

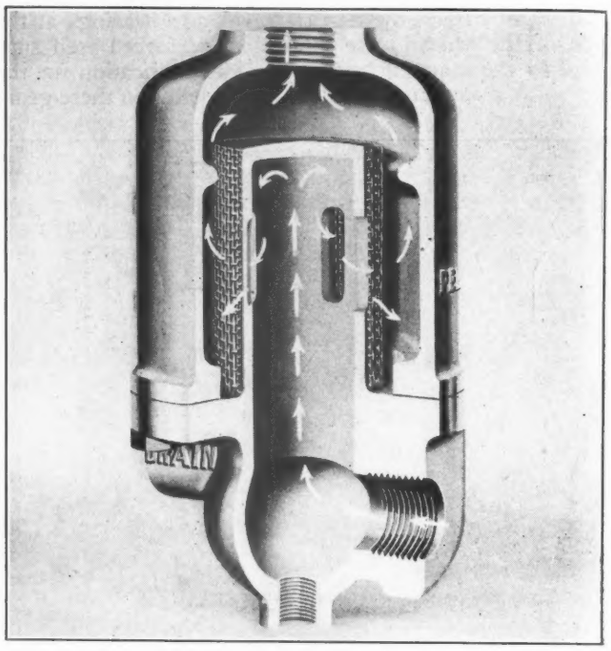
WATER in compressed air is the source of a number of troublesome and expensive difficulties. It accumulates in pipes and causes rust and subsequent fouling. Water hammer may develop and cause loosened joints and air leaks. But more important is its effect on pneumatic tools and appliances. Water will exclude the lubricant from valves, pistons and other moving parts and by doing so cause added friction and more rapid wear.

An oil and moisture separator, manufactured by the Smith-Monroe Company, 223 South Main street, South Bend, Ind., is designed to remove oil and moisture, and deliver dry, clean air.

Compressed air carrying oil and moisture enters the separator through the horizontal inlet as shown by the arrows in the illustration. It travels upward to the top of the inner chamber, where it is deflected downward and out horizontally through the slotted openings into the outer chamber. Surrounding the inner chamber and covering the slotted openings are many thicknesses of coarse brass screen which serve to impede the flow of air through the opening, forcing it to follow a zig zag course through the screen to reach the outer chamber.

This rapid change of direction over a short distance of travel causes the moisture and oil carried by the air to be deposited on the strands of the screen and to fall into a dead air space at the bottom of the outer chamber. Before the air leaves the outer chamber it must pass around a projection cast in the upper part. This projection prevents any capillary action and keeps the air in the upper chamber free from moisture.

The water and oil which collect in the ring at the bottom of the outer chamber drain off through a drop pipe with a shut-off valve. To make the operation entirely mechanical, the drain may be connected to an Armstrong trap which will automatically discharge the collected water and oil. At the bottom of the separator is a smaller opening which is merely a low point drain. It can be fitted with a short drop pipe and a small air cock.

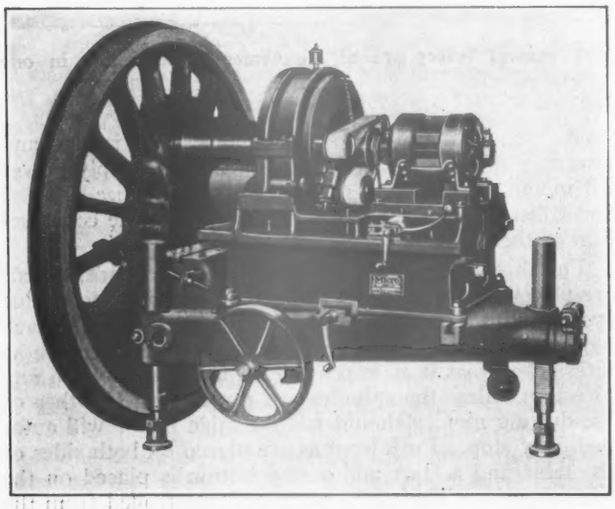


The Gast compressed air, oil and moisture separator

These separators are supplied in sizes to fit either ¾ in. or 1 in. pipes. A separator is put on each line.

Micro portable locomotive crank pin grinder

THE portable grinder, shown in the illustrations, for grinding out-of-round locomotive crank pins, has recently been placed on the market by the Micro Machine Company, Bettendorf, Iowa. With the standard spindle furnished, this machine will grind locomotive crank pins ranging in diameter up to 10 in. and having bearing lengths up to and including 9¾ in. It will grind in one setting all single diameters of side rod pins and both diameters of main pins up to a total length of 20 in. The machine can be applied to driving wheels. either under or out of the locomotive.



The Micro portable locomotive crank pin grinder

The grinding is accomplished with a series of grinding wheels mounted on a ball bearing spindle which revolves around the pin. The spindle is eccentrically mounted in a ring type main bearing provided with a coarse and fine automatic feed for increasing the depth of grinding cut while the main bearing revolves. A ¾-in. longitudinal oscillating movement of the headstock on its slideways, actuated by means of a cam located under the motor, insures uniform wear of the grinding wheels and eliminates any tendency toward a taper condition. The driving cam of this oscillation is so timed with the main bearing that the path of the grinding wheels changes continually. A line on the outer diameter of the cam provides the operator with a means for adjusting the stroke or travel of the slide without the possibility of having the wheel overtravel.

The drive gear assembly for the cam is completely housed under the motor mounting pad and runs in a bath of oil. The power drive of the cam can be disengaged with a wrench in order to obtain a long travel of the slide in dressing the grinding wheels with a diamond

which is clamped rigidly in an adjustable holder mounted on the base of the machine.

The truck frame is cast steel. The pads for squaring the machine to the wheel and for supporting the bed are cast integral. Three jacks of the rack type for elevating and leveling the machine are operated universally by a hand crank through gearing and independently with a wrench on threaded foot pads.

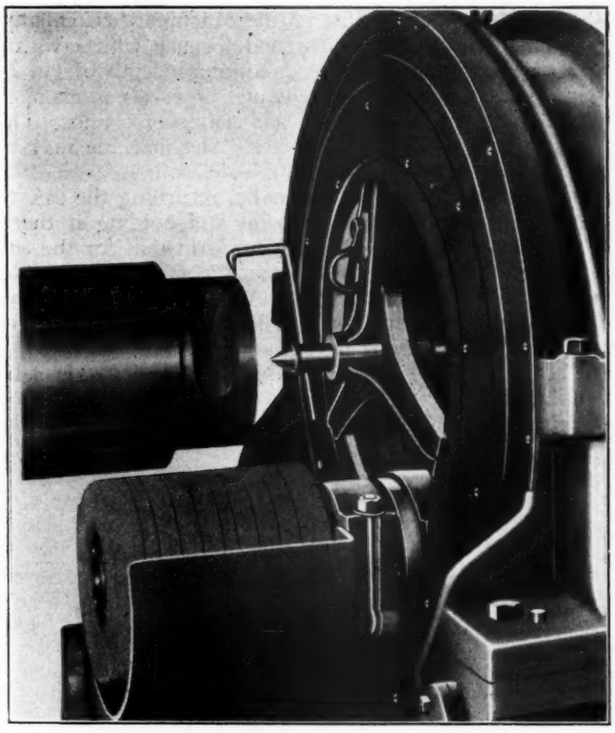
The bed is a ribbed cast-iron unit. Each slideway is 2⅞ in. wide by 39 in. long; the width over both ways is 29⅜ in. The cross slide, used for quick centering, is provided with lock nuts at four corners and when these nuts are tightened the slide becomes an integral part of the truck frame.

The headstock and carriage are cast integral. The slides are protected from dust and equipped with take-up gibs and adjusting screws to compensate for wear. The headstock power engaging clutch is operated by a conveniently located lever. A crank is provided for revolving the main bearing by hand.

The machine is driven by a 7½-hp., 1,750 r.p.m. motor. The machine requires a floor space of 5 ft. by 6 ft.

The machine may be set-up in 15 to 20 min. The finished squaring pad on the end of the base is butted against the finished hub face of the driving wheel and anchored tightly with a chain lashed around two spokes. The outer jack is then raised or lowered until the machine is square with the hub face. The centering of the grinding circle to the pin is completed by raising or lowering the entire machine.

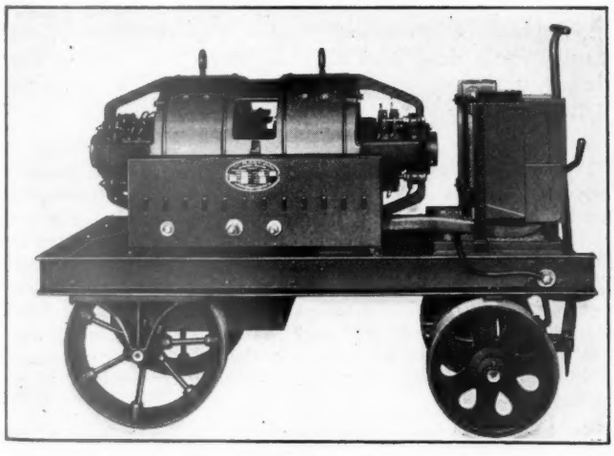
One of the illustrations shows the removable centering spider in the main cylinder. The sliding center bar is pointed to coincide with the original lathe center of the pin. A final check can be made by revolving the needle around the outer end of the main pin, as illustrated.



The removable centering spider

The Mann two-operator electric arc welder

THE Mann electric arc welder, shown in the illustration, is a two-operator, 300 ampere, portable machine, manufactured by the Electric Welder Controller Company, 602 Bigelow boulevard, Pittsburgh, Pa. The machine furnishes welding current for two



The Mann two operator, 300 ampere, portable type electric arc welder

men, simultaneously, with no interference between the operators. The unit may also be used as a single operator set by paralleling the two welding leads. Operating in this manner, the operator will have a range of current from 10 to 350 amperes, and he can use any size of electrode from 1/32 in. to ⅜ in. The machines driven by direct current are furnished with commutators at both ends. The machine has an emergency step for intermittent cutting at 700 amperes and will cut through and burn fitting holes in plates up to ½ in. in thickness.

The generator will supply from 36 to 40 volts, but will give arc voltage as high as 10 volts for starting and momentarily bridging gaps. The driving motor is 15 hp. Ball bearings are standard on all units. The control system is by push button or toggle switch control in steps of 10 and 20 amperes. The machine is fully equipped with the necessary accessories, including all welding leads, an electrode holder with a flexible cable, a hand shield and a wire brush. A welder's locker or tool box is provided on each unit.

STAINLESS STEEL AND STAINLESS IRON.—Working instructions for Bethlehem stainless steel forging and stainless iron forging are given in Booklet No. 113 which has been issued by the Bethlehem Steel Company, Bethlehem, Pa. These metals can be rolled, forged, pressed and hammered, and can be used for machinery parts, especially those subjected to strong corrosive agents.

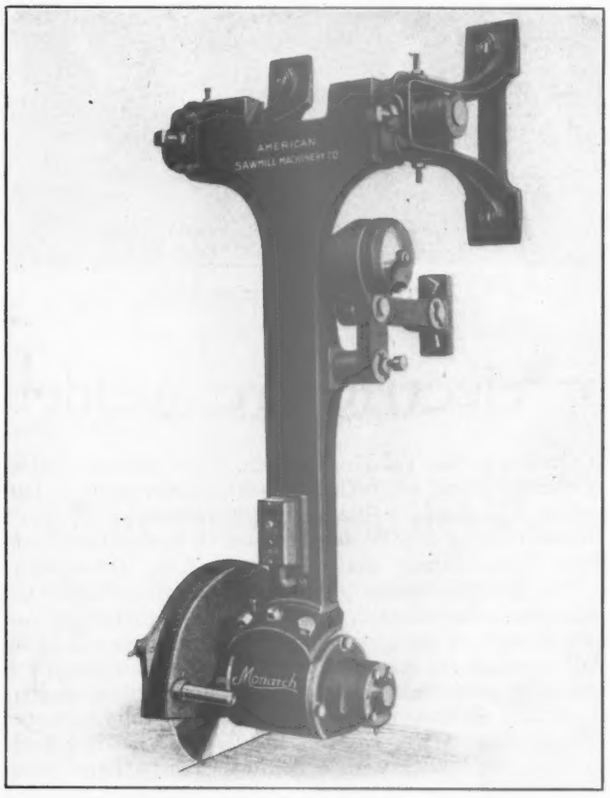
PNEUMATIC COLLECTING AND CONVEYING SYSTEMS.—The B. F. Sturtevant Company, Hyde Park, Boston, Mass., has issued catalogue No. 291 describing the advantages of pneumatic conveying systems, conveying of fibrous materials, and dust collectors for sand blast machines, grinding and polishing wheels, etc. Part 2 of the catalogue includes data covering the design and application of collecting systems, the engineering method and design used in dust conveying systems, size of connections for grinding, polishing wheels and woodworking machinery, and other miscellaneous tables and engineering data.

Motor-in-head swing saw

A MOTOR-IN-HEAD swing saw manufactured by the American Saw Mill Machinery Company, Hackettstown, N. J., is designed for use with saws up to 16 in. in diameter with a maximum depth of cut of 4 in. The frame is of the channel type. It is clamped to the shaft with vee-shaped self-centering clamps. The shaft turns on the hanger boxes. The machine may be suspended from the ceiling or a side wall.

The counterbalance is automatic, returning the saw to the back position from any point and holding it there. It is arranged to give an even, uniform pull for the full stroke of the saw and also acts as a safety stop at the end of the forward movement. A guard completely covers the saw above the working depth. The outside cover is removable for changing saws.

The motor is contained within the head. It is self-ventilating and protected from chips and dust. Air is taken in through a sieve at the outer end and discharged

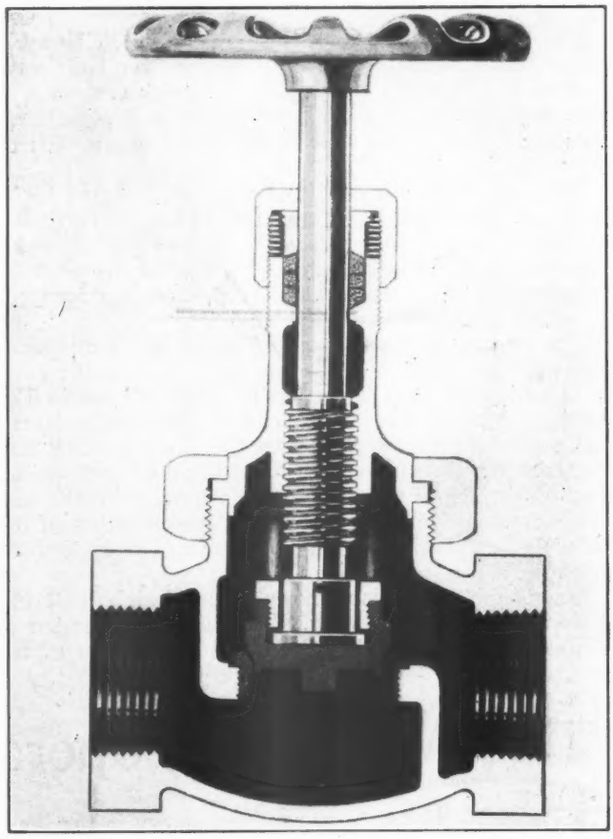


A motor driven swing saw with compensating counterbalance

through the motor into the hood which covers the saw. The motor is 1-hp. 3-phase, of the ball-bearing type. A larger motor can be furnished when required. The motor is provided with a magnetic starter with push-button control.

Walworth railroad valve

TO cope with increasingly heavy locomotive service, the Walworth Company, Boston, Mass., has developed a valve, incorporating certain features for the purpose of reducing labor on locomotive pipe lines. The heavy, rugged construction of the valve—known as the Walworth railroad valve, for 300 lb. working steam pressure at a total temperature of 600 deg.—especially fits it to resist vibration, expansion and contraction. A heavy duty bronze body and bonnet, a forged bronze stem with acme thread and a heavy hexagonal union bonnet ring are the essential parts of the valve. The nickel seat ring and disc are of the renewable type. The use of a seat wrench permits of easy removal of the seat ring and



This valve is designed for 300 lb. steam pressure and 600 deg. temperature

the insertion of a new one. This may be done with a minimum of labor and time. The valve may be packed under pressure while wide open. The stuffing nut and gland have a deep packing chamber. The valve is furnished in sizes from ¼ in. to 3 in., inclusive, in globe, angle and cross types, both screwed and flanged.

INDUSTRIAL GEARS.—Engineering information on speed reducers, conveying equipment, gears of all kinds, mathematical tables, and considerable engineering information on mechanical engineering subjects are contained in general catalogue No. 200 issued by the Foote Bros. Gear & Machine Company, 215 N. Curtis street, Chicago. The entire line of IXL worm, spur and herringbone speed reducers, couplings, bases and industrial gears of every size and kind are listed, with prices, ratings and dimensional data. The pages are indexed by subjects in the upper page corners, and a complete cross-reference index is provided in the back of the catalogue.

STEAM GENERATORS.—The factors of gravity, adhesion, cohesion, the relation of the steam bubble and surface tension as functioning in the old and new ways of making steam are analyzed and compared in a 20-page booklet entitled, "The New Way of Making Steam," which has been issued by the La Mont Corporation, 200 Fifth avenue, New York City. The La Mont steam generator described is suitable for industrial furnaces of any character discharging waste gases at a heat of 750 deg. or over. Its free film evaporation permits the application of the laws which have come to be recognized as governing the efficient transfer of heat.

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

Hearings were begun at Washington on February 10 on a complaint filed by the Bangor & Aroostook and others against the American Railway Association protesting against the rules and interpretations governing the compensation for rebuilt cars destroyed when away from home, in which, according to the complaint, the depreciated cost of reproduction of a car is to be calculated from the date of the original construction of the car from which materials were taken to make the rebuilt car. According to the complaint this has resulted in the compensation being based on an amount less than the car trust certificates issued against the rebuilt cars.

Average car mileage and car load for 1926

The daily average movement of freight cars in the United States in 1926, according to reports for the year compiled by the Bureau of Railway Economics, was 30.4 miles a day. This exceeded by 1.9 miles the average for 1925 and by 3.6 miles the average for 1924.

The average showed a progressive improvement throughout the year, the highest average for any one month on record having been attained in October, 1926, when it was 34.2 miles per day. This speeding up in the handling of freight cars was due not only to the more prompt movement of both loaded and empty cars by the railroads but also to the more prompt loading and unloading of freight cars by shippers.

The average load per freight car in 1926 was 27.4 tons, which was four-tenths of one ton greater than that for 1924 or 1925. It was, however, one-half a ton below the average for 1923.

Suburban cars to have roller bearings

Roller bearings are specified on 40 new all-steel passenger cars, which were recently ordered by the Chicago, Rock Island & Pacific for Chicago suburban service. The order for bearings is divided between the Hyatt Roller Bearing Company, Newark, N. J., S. K. F. Industries, Inc., New York City, and the Timken Roller Bearing Company, Canton, Ohio. The use of these cars, all in the same service, where maintenance standards are high and inspection close, will afford the most extensive and accurate comparative test of roller bearings in railway service yet attempted. Present plans contemplate the transformation of all suburban cars of the Rock Island into all-steel, electric-lighted, roller bearing cars during the present year.

The Chicago & North Western also has specified roller bearings on 100 new suburban cars and 20 combination passenger and baggage cars recently ordered. These 120 cars will be equipped with Hyatt roller bearings in Melcher 5-in. by 9-in. journal boxes, furnished by the Railway Motors Corporation, De Pere, Wis.

Overheated wheels due to blocked retaining valve orifice

V. R. Hawthorne, secretary, Mechanical Division, American Railway Association, has brought to the attention of the members in circular D. V. 500 that the committee on Brakes and Brake Equipment has recently had called to its attention the fact that retaining valves are not given proper consideration as cars are being painted. Instances are reported wherein, due to carelessness in painting, the ports in the retaining valves are blocked with paint, particularly the small vent port in the retaining valve cap or body, causing the improper operation of the retaining valve and, in some cases, overheated and broken wheels.

There has been more or less complaint of this nature from time to time and the committee believes that each railroad should call the attention of their air-brake repairmen and also those in charge of painting cars to this practice, in order that inspection will be made following the painting of cars to determine that the exhaust and vent ports are not obstructed or that suitable provisions will be made to protect the retaining valves while cars are being painted.

Decrease in amount of work turned out by repair shops

The Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1926, the repair shops of steam and electric railroad companies reported work done during the year 1925 to the aggregate value of $1,332,679,000, a decrease of 12.3 per cent as compared with $1,520,093,000 for 1923, the last preceding census year. For steam railroad repair shops alone the total was $1,248,867,000, a decrease of 12.9 per cent as compared with 1923, and for electric railroad repair shops it was $83,812,000, a decrease of 3 per cent.

Summary for steam railroad repair shops: 1925 and 1923

SUBJECT TO CORRECTION

	1925	1923	Per cent of increase (+) or decrease (—)
Number of shops	1,842	1,801	+2.3
Wage earners (average number)*	425,234	488,505	—13.0
Maximum month	Feb. 438,308	June 500,604	.....
Minimum month	Aug. 416.961	Dec. 458,039	.....
Per cent of maximum	95.1	91.5	.....
Wages	$619,834,000	$723,742,000	—14.4
Cost of materials (including fuel, electric power, and shop supplies)	$533,908,000	$599,377,000	—10.9
Value of work done	$1,248,867,000	$1,433,680,000	—12.9
Value added by manufacture†	$714,959,000	$834,303,000	—14.3

*Not including salaried employees.
†Value of work done less cost of materials.

DETAILED STATISTICS

	1925	1923	Per cent of increase (+) or decrease (—)
Total value of work or products	$1,248,867,000	$1,433,680,000	—12.9
Motive power and machinery departments	$622,345,000	$720,295,000	—13.6
New construction	4,061,000	6,322,000	—35.8
Repairs	469,036,000	555,775,000	—15.6
Work for other corporations	10,258,000	13,810,000	—25.7
All other work or products	138,990,000	144,388,000	—3.7
Car departments	540,753,000	628,463,000	—14.0
New construction	6,908,000	15,704,000	—56.0
Repairs	451,814,000	504,166,000	—10.4
Work for other corporations	19,164,000	24,355,000	—21.6
All other work or products	62,927,000	84,238,000	—25.3
Bridge and building departments (shop work only)	5,316,000	6,960,000	—23.6
Repairs and renewals	4,774,000	5,783,000	—17.4
Work for other corporations	60,000	77,000	—22.1
All other work or products	482,000	1,100,000	—56.1
All other work or products, not reported in detail	80,453,000	77,962,000	+ 3.2

Equipment installed

Class I railroads in 1926 placed in service 2,399 locomotives, according to reports compiled by the Car Service Division of the American Railway Association. This was an increase of 666 locomotives over the number installed in 1925 and of 153 over the number installed in 1924.

The actual number of locomotives owned on January 1, 1927, totaled 62,428, or a decrease as compared with January 1, 1924, of 2,468 locomotives, but the average tractive power per locomotive was approximately 6.7 per cent greater than it was three years ago.

Class I railroads on January 1, this year, had 329 locomotives on order, compared with 471 one year before, and 287 on January 1, 1925.

Freight cars installed in 1926 totaled 104,000, a decrease of

24,422 compared with 1925 and of 52,414 compared with 1924. Of the total, box cars numbered 46,063; coal cars, 41,084, and refriferator cars, 8,471.

While the number of freight cars owned on January 1, 1927, was an increase of 28,473 cars, or 1.2 per cent compared with January 1, 1924, the average carrying capacity per car was 45.3 tons, as compared with 43.5 tons three years ago, or an increase of 4.1 per cent. These figures as to freight cars and locomotives include new and leased equipment.

Shop accidents reduced on A. C. L.

Competition in safety records, one of the methods for promoting diligence and enthusiasm among employees in the preservation of their own lives and limbs and those of their fellow workmen, has been a feature of the service in two shops of the Atlantic Coast Line during the past year; the plant at Emerson, employing 2,006 men and that at Waycross employing 2,176. Waycross challenged Emerson, and the results of the intensive work done by the shop superintendents and their foremen are shown in the following figures:

Emerson shop plant:		
Average employees on duty 1916	2,006	
Average for previous six years	1,551	
Increase in employees		455 = 29 p.c.
Average number injured per year during previous six years	106	
Number injured during 1926	52	
Decrease in injuries		54 = 51 p.c.
Waycross shop plant:		
Average employees on duty, 1926	2,176	
Average employees, previous six years	1,693	
Increase in employees		483 = 20 p.c.
Average number injured per year, during previous six years	169	
Number injured during 1926	60	
Decrease in injuries		109 = 64 p.c.

While Waycross shop plant showed a larger reduction in accidents over her previous record, the rate per 100 employees on duty gave to Emerson shop the lead by a small margin, and that shop was declared the winner.

Meetings and Conventions

The sixth division of the American Railway Association, Purchases & Stores, will hold its annual meeting at the Palmer House, Chicago, on May 24, 25 and 26.

International Congress of Refrigeration

An International Congress of Refrigeration will be held at Rome, Italy, on September 19 to October 1, 1927, under the auspices of the Italian government and the Institute International de Froid, which is a permanent body of the different governments that take membership direct. The United States is represented by the American Association of Ice and Refrigeration, of which J. F. Nickerson, Chicago, is secretary. The subjects to be considered at the meeting are divided into technical and commercial. Those under the former include the systematic selection and examination of various types of so-called refrigerator cars; the uniform classification of special cars for the transport of foodstuffs; the stowage and packing systems of goods in cars; the provisions and regulations for pre-cooling; technical instruction on the working and control of refrigerator cars; regulations to be followed in case of prolonged stoppage; provisions to be considered for railroad transport over various distances; and the creation of experimental stations for rolling stock. The commercial section includes a special itinerary for the rapid international transport of perishable produce; the selection of stations for reloading of cars with ice, salt, water, etc.; the obligations on the part of the consignor relative to the declarations, packing and preserving of goods; the establishment of bases for the enforcing of special operations necessary for the preservation of goods; and facilities to be accorded for the transport of packing ice and straw. Other questions to be considered include the means whereby goods can keep their mark of origin during international transport; adoption of a uniform method of inspection of refrigerated produce; examination of a special insurance scheme for easily perishable goods; and institution of international councils of arbitration to deal with litigation arising out of transport of perishable produce.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—T. L. Burton, acting secretary, 165 Broadway, N. Y. Next meeting May 24, 25, 26 and 27, Mayflower Hotel, Washington, D. C.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 7, 8 and 9, Hotel Windsor, Montreal.

Division V—Equipment Painting Section.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Annual meeting May 24, 25 and 26, Palmer House, Chicago.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention, Chicago, August 31, September 1 and 2.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

American Society for Steel Treatment.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, Hotel Sherman, Chicago, October 25-28.

Birmingham Car Foremen and Car Inspectors' Association.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. Building.

Canadian Railway Club.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting March 8. Paper on railway mail will be presented by P. T. Cooligan, deputy postmaster general, Ottawa.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago.

Car Foremen's Association of St. Louis.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Regular meeting first Tuesday in each month, except June, July and August.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting March 10, Hotel Statler, Buffalo. Lecture, illustrated with moving pictures of manufacture of solid rolled steel wheels and the production of freight cars will be given by G. A. Richardson, manager, technical publicity department, Bethlehem Steel Company.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt railway, Clearing Station, Chicago. Annual convention, Chicago, September, 1927.

Cincinnati Railway Club.—D. R. Boyd, 811 Union Central Building. Regular meeting second Tuesday February, May, September and November.

Cleveland Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Lafayette, Buffalo, N. Y., August 16-18, 1927.

International Railway Fuel Association.—L. G. Plant Railway Exchange, 80 E. Jackson Boulevard, Chicago. Annual convention May 10 to 13, 1927, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Chicago, September 6-9, 1927.

Louisiana Car Department Association.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting Chicago, May 3-6, 1927.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting March 8. Election of officers and moving pictures on fighting big salmon in New Brunswick, by E. S. Jones, travel lecturer.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. G. H. Sines, assistant to vice-president, Union Pacific, will be the speaker at the March 18 meeting.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco. Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting March 10, Fairmont Hotel, San Francisco. Paper on the railroad problems of today will be presented by W. B. Storey, president, Atchison, Topeka & Santa Fe. Tenth annual meeting and banquet.

Railway Club of Greenville.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meeting third Thursday in January, March, May, July, September and November.

Southeastern Carmen's Interchange Association.—C. Kimball, Inman shops, Southern, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1927.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

Powell Stackhouse, formerly president of the Cambria Steel Company, died on February 4 at St. Petersburg, Fla.

G. M. Lawrence has been appointed sales manager of the United States Electrical Tool Company. Mr. Lawrence was formerly district manager from the Cleveland office.

Edward McCabe, senior member of the firm of E. McCabe & Co., Lawrence, Mass., died at his home in Lawrence on February 8. He was actively engaged in the boiler business for 55 years.

Harry Howe has been appointed engineer of railway equipment of the Manganese Steel Forge Company, Philadelphia, Pa. Mr. Howe resigned as special engineer for the Pressed Steel Car Company after 21 years' service.

W. H. S. Bateman has been appointed district sales manager of the Detroit Seamless Steel Tubes Company, Detroit, Mich., in charge of the southeastern district, with headquarters at 823 Commercial Trust building, Philadelphia, Pa.

G. LaRue Masters, in charge of sales in the United States and Canada, of the car window equipment department of the National Lock Washer Company, Newark, N. J., has been appointed assistant general sales manager of the company.

The Geo. M. Coale Company on February 1 succeeded to the business of the Coale-Fraser Lumber Company, Chicago, Geo. M. Coale having bought the interest of W. B. Fraser, the invested capital and balance of the organization remaining as heretofore.

Charles R. Long, Jr., president of the Charles R. Long, Jr., Company and vice-president of the Viloco Railway Equipment Company, Chicago, has been elected president of the latter company, to succeed G. S. Turner, resigned. G. E. Johnson, assistant secretary, has been promoted to secretary.

The Pullman Company will be reorganized through the formation of a holding company to take over the Pullman Company and the Pullman Car & Manufacturing Corporation; stocks to be exchanged on a basis of two and one-half shares of new stock for one share of old. At a meeting of the board of directors on January 31, a committee was appointed to carry out a plan for the reorganization.

James G. Bateman, assistant manager of sales of the National Tube Company, at New York, and vice-president of the Engineers' Club, died on February 2 of pneumonia at the Engineers' Club, where he lived. Mr. Bateman was born at Easton, Md., 49 years ago. He served consecutively with the Erie, The Symington Company and for a short time with the Delaware & Hudson, at Albany, previous to 1907, and since that time had been associated with the National Tube Company.

The T Z Railway Equipment Company, Lytton building, Chicago, has been organized by G. S. Turner, president; F. S. Zimmerman, vice-president, and F. J. Kearney, vice-president. Mr. Turner was formerly president of the Viloco Railway Equipment Company, vice-president of the Okadee Company, the Charles R. Long, Jr., Company and the Viloco Machine Company. Mr. Zimmerman was formerly vice-president and secretary of the Viloco Railway Equipment Company and the Okadee Company, assistant secretary of the Charles R. Long, Jr., Company and secretary-treasurer of the Viloco Machine Company. Mr. Kearney was formerly mechanical expert for the same companies.

Justus H. Schwacke, former president of William Sellers & Co., Inc., Philadelphia, Pa., died on February 17 at Boca Grande, Florida, at the age of 79. Mr. Schwacke had served the company continuously from July 15, 1862, to May 31, 1926, when he resigned and retired to private life. He was elected secretary when the company was incorporated in 1886, director in 1902, manager in 1905 and president in 1922. He was active since their formation in a number of associations including the National Metal Trades Association, of which he was president for the year 1910-11, and served also for several years as president of the Metal Manufacturers Association of Philadelphia.

H. O. K. Meister has been appointed general sales manager and A. W. Scarratt, chief engineer of the Hyatt Roller Bearing Company, Newark, N. J. Mr. Meister joined the Hyatt forces more than fourteen years ago, serving first as an engineer at the home office in Newark. Later he was transferred to the Chicago office where, after a few years, he took over the supervision of Hyatt sales work in the western territory. Eighteen months ago he was appointed assistant sales manager, with headquarters at Newark, where he will continue to be located as general sales manager. Mr. Scarratt is experienced in the design and construction of automotive, tractor, railroad and industrial equipment. He joined the Hyatt engineering staff a few months ago as assistant chief engineer. His headquarters are at Newark. The Pittsburgh offices of the Hyatt Roller Bearing Company, recently named as headquarters for the central sales division, are now located at 806 Fulton building. They were formerly at 1352 Union Trust building. B. H. Lytle is in charge of the central division. H. R. London has joined the Pittsburgh force.

L. E. Osborne, mechanical engineer of the Locomotive Stoker Company, died on January 30, in the Bellevue Suburban Hospital, Pittsburgh, Pa., following an attack of pneumonia, at the age of 45 years. Mr. Osborne received his technical education at the George Peabody College, Nashville, Tenn., and the Virginia Polytechnic Institute. After he graduated from the latter school in 1906 he entered the service of the Norfolk & Western and worked for three years in the mechanical department under J. A. Pilcher. In 1909 he joined the engineering staff of the Westinghouse Air Brake Company, where he assisted in the development of the Street mechanical stoker. When the Locomotive Stoker Company was formed in 1913 and located at Schenectady, N. Y., he was one of the original staff of employees, serving in the capacity of designing engineer. Upon removal of the company to Pittsburgh in 1916, he was appointed mechanical engineer.

L. E. Osborne

Benjamin Nikolas Broido, chief engineer of the industrial department of the Superheater Company, New York and Chicago, died suddenly at his home in New York on February 10. Mr. Broido was known as a designer of exceptional ability of steam superheaters and heat exchange apparatus. He was born in Wilna, Russia, in January, 1879. His early education was obtained in Germany, and he graduated in 1904 from Frederick's Polytechnic, Gothen, Germany, with a degree in mechanical engineering. For the next two years he was an instructor at the Polytechnic. From 1906 to 1912, Mr. Broido was connected with Aschersleb ner Maschinenbau A. G., Aschersleben, Germany. He then became connected with Hannoversche Maschinenbau A. G., Hanover, Germany, where he developed a new design of Stirling boiler. Mr. Broido came to the United States in 1914 and took a post-graduate course in the City College of New York and Columbia University. Later he became connected with the Roessler and Hasslacher Chemical Company, Perth Amboy, N. J., for whom he designed power plants. In 1917, he was engaged by the Reading Company to design a power and creosoting plant. At the end of 1917 he became connected with The Superheater Company as designing engineer in charge of design and development of Elesco superheaters for stationary boilers. As a member of the American Society of Mechanical Engineers, he took an active part in steam power plant work, and presented a number of papers on steam boiler development at various meetings of the society. In the past nine years Mr. Broido has filed over 75 patent applications in this country and abroad for boilers, superheaters, economizers, heat exchangers, pipe stills, etc. He also

contributed a number of articles in engineering magazines on diverse subjects.

Cary D. Terrell, who has been elected vice-president of the American Car & Foundry Company, with headquarters at Chicago, graduated from the engineering department of the University of Michigan and then completed a special apprenticeship course in the Burnside shops of the Illinois Central, Chicago. He later served as associate editor of the Railway and Engineering Review, Chicago. Mr. Terrell was then engaged in special work in the mechanical department of the Atchison, Topeka & Santa Fe, Coast Lines, and subsequently served in the sales department of the Pressed Steel Car Company at Pittsburgh, Pa., at New York City and at St. Louis, Mo. In 1910 he entered the sales department of the American Car & Foundry Company at St. Louis and was transferred later to Washington and then to Chicago. Mr. Terrell was appointed assistant vice-president in the Chicago office in October, 1922, and was placed in charge of sales, Chicago district, in November, 1925, serving in that position until his election as vice-president, as above noted.

C. D. Terrell

John T. Carroll, who resigned as general superintendent motive power and equipment of the Baltimore & Ohio to enter the railway supply business, was born on June 12, 1879, at Cassandaga, N. Y. He was educated at Purdue University, and in September, 1891, entered the service of the Brooks Locomotive Works as draftsman, remaining there until January, 1896. He was then, until the following April, draftsman on the Erie, at Susquehanna, Pa., and later served as draftsman on the Chicago, Rock Island & Pacific until October, 1897. He then went as draftsman with the Chicago & North Western and from September, 1898, to June, 1899, was a student at Purdue University, after which he returned as a draftsman to the Chicago & North Western. From August, 1899, to December, 1904, he was mechanical engineer on the New York, Chicago & St. Louis and then until April, 1906, he served as chief draftsman on the Lake Shore & Michigan Southern. He subsequently served for a short time as assistant general foreman and from May, 1906, to January, 1907, as general foreman, then for one year as assistant superintendent of shops. From January to November, 1908, he was assistant master mechanic, and then until May, 1910, master mechanic of the same road. Mr. Carroll served from May, 1910, to February, 1912, as superintendent motive power of the Baltimore & Ohio, then to June, 1918, as assistant general superintendent motive power on the same road. From June to December, 1918, he was mechanical assistant to the regional director, Allegheny Region, United States Railroad Administration and on the latter date returned to the Baltimore & Ohio, serving as general superintendent motive power and since June, 1925, as general superintendent motive power and equipment until his resignation.

J. T. Carroll

Trade Publications

Leather belting.—A reprint of an article on individual drive as compared to group drive with belts for industrial machinery, by L. H. Hopkins, is contained in the booklet issued by Chas. A. Schieren Company, 37 Ferry street, New York.

Sling chains.—A circular and price list on the various styles of the Taylor-Mesaba sling chains has been issued by the S. G. Taylor Chain Company, 140 South Dearborn street, Chicago. Tables give the safe working loads on single and double sling chains.

Welding rod.—A new viewpoint on metallic arc welding costs is outlined in a 12-page booklet prepared by the Chicago Steel & Wire Compay, 103rd street and Torrence avenue, Chicago. The Weldite line of rods for both gas and electric welding are briefly described in this booklet.

Sludge remover.—The details of piping and mounting of apparatus on the B.-A. sludge remover are shown in a 16-page brochure descriptive of the B.-A. Co. sludge remover and locomotive blow-off cocks which has been issued by the Bird-Archer Company, 33 Rector street, New York.

Reclaiming scrap car axles.—Itemized estimates of the costs and economies effected by the use of the Model 6-in. twin geared upsetting forging machine for reclaiming scrap car axles are tabulated in an eight-page bulletin issued by the Ajax Manufacturing Company, Euclid, Cleveland, Ohio.

Acetylene generators.—The Air Reduction Sales Company, 342 Madison avenue, New York, describes in Catalogue Section No. 5 Davis-Bournonville acetylene generators. These generators, manufactured in 50, 100 and 300-lb. carbide capacities, are operative up to a maximum of 15 lb. pressure.

Universal grinding machines.—The Thompson 10-in. by 36-in. Universal grinding machine is described and illustrated in Bulletin No. 17 issued by the Thompson Grinder Company, Springfield, Ohio. Erecting plans of the separate countershaft and self-contained motor-driven types are shown.

Mechanical drive turbines.—The General Electric Company, Schenectady, N. Y., describes in Publication GEA-578 Type D mechanical drive turbines for centrifugal pumps. These turbines can be arranged to operate at steam pressures up to 400 lb. and steam temperatures up to 725 deg. F.

Fans and blowers.—The American Blower Company, Detroit, Mich., gives in Bulletin No. 8001 a brief description of the mechanical construction of the American "Sirocco" fan, together with complete capacity and dimension tables for the engineer's use. The "Sirocco" Utility blower is also described.

Electric furnaces.—Resistor furnaces, suitable for the heat treatment of high speed steel and general purposes requiring temperatures up to 1,400 deg. C., are described in an 8-page bulletin issued by Automatic & Electric Furnaces, Ltd., Elecfurn Works, 173 Faringdon Road, London, E.C. 1, England.

Graphic meters.—The Esterline-Angus quick trip graphic instrument for recording hydraulic pressures is described and illustrated in Bulletin No. 1026, issued by the Esterline-Angus Company, Indianapolis, Ind. The Esterline-Angus recording ammeter for use in radio telegraph stations is also described.

Dynamometers.—The General Electric dynamometers for the measuring of torque or power of internal combustion engines, or the investigation of every part of automotive engine equipment, separately or in combination, is described and illustrated in Bulletin GEA-544 issued by the General Electric Company, Schenectady, N. Y.

Nickel steel.—Curves showing the average values of tensile strength, elastic limit, reduction of area, elongation and Brinell hardness at various drawing temperatures are given for the S. A. E. standard nickel and nickel-chromium steels in Bulletin No. 9 issued by the International Nickel Company, 67 Wall street, New York.

Personal Mention

General

SAMUEL LYNN, master car builder of the Pittsburgh & Lake Erie and the Lake Erie & Eastern, at McKees Rocks, Pa., has been appointed superintendent of rolling stock, with the same headquarters.

CHARLES JAMES, mechanical superintendent of the Ohio region of the Erie at Youngstown, Ohio, has been appointed mechanical superintendent of the Eastern district, with headquarters at Hornell, N. Y.

GEORGE T. DEPUE, mechanical superintendent of the Chicago region of the Erie, at Chicago, Ill., has been appointed mechanical superintendent of the Western district, with headquarters at Youngstown, Ohio.

JAMES PAUL, assistant superintendent of motive power of the Atlantic Coast Line, has been appointed superintendent of motive power of the Third division, with headquarters at the Tampa Shops, Tampa, Fla.

JOHN W. MCVEY, research engineer of the Boston & Maine, at Boston, Mass., has been appointed supervisor of locomotive performance, in charge of road foremen of engines and fuel department, with the same headquarters.

WILLIAM S. JACKSON, mechanical superintendent of the New York region of the Erie at Jersey City, N. J., has been appointed superintendent of motive power of the system, with headquarters at New York. Mr. Jackson was born on August 12, 1878, at Ashtabula, O., and was educated in the public schools. He entered railway service in September, 1894, with the Lake Shore & Michigan Southern (now a part of the New York Central), and until 1911 was consecutively foreman and general foreman. From 1911 until 1916, he was with the Interstate Commerce Commission as locomotive inspector and since 1916 has served successively as master mechanic and mechanical superintendent.

RUFUS H. FLINN, who has been appointed superintendent of motive power of the Northern division of the Central region of the Pennsylvania, with headquarters at Buffalo, N. Y., was born on March 8, 1887, at Camden, N. J., and was graduated from Cornell University with the degree of M. E. in 1909. He entered railway service on July 1, 1902, as assistant draftsman in the Camden, N. J., shops of the Pennsylvania. He became locomotive fireman on the West Jersey & Seashore in June, 1906, and was transferred to the Columbus, Ohio, shops as special apprentice on June 28, 1909. From February, 1911, until June, 1912, he was engaged in special work for the general superintendent of motive power at Pittsburgh, and from the latter date until May, 1913, was motive power inspector in the office of the superintendent of motive power at Columbus, Ohio. He was general foreman at Louisville, Ky., from May, 1913, to January, 1915, and was then transferred in the same capacity to Bradford, Ohio, where he remained until June, 1916. Mr. Flinn then served as assistant master mechanic at Allegheny, Pa., from June, 1916, until November, 1917, and then became assistant engineer of motive power at Toledo, Ohio, which position he held until July, 1918, when he became master mechanic at Terre Haute, Ind. He served in this capacity successively at Indianapolis, Ind., and at Columbus, Ohio, where he was stationed at the time of his recent appointment.

R. H. Flinn

W. G. BLACK, until recently superintendent of motive power of the New York, Chicago & St. Louis, has been appointed mechanical assistant to the president of the Erie, with headquarters at Cleveland, Ohio. Mr. Black was born at Lima, Ohio, on April 19, 1877. His early education was received in the grammar schools and supplemented with a business education at Metropolitan Business College, Chicago. In 1893 Mr. Black entered the service of the Nickel Plate and served a machinist apprenticeship at its Stony Island shops, Chicago. After completing his apprenticeship he entered Armour Institute, Chicago, in 1897 for the purpose of taking a post-graduate mechanical course, on completing which he entered the service of the Illinois Central at Burnside shops, Chicago, as a machinist, continuing in that capacity until 1900 at which time he left railroad service and was employed by the Illinois Steel Company at the South Chicago plant until 1903. On February 10, 1903, Mr. Black re-entered the service of the Nickel Plate as a machinist and was promoted to machine shop foreman July 1, 1903. On February 1, 1904, he was promoted to enginehouse foreman at Fort Wayne, Ind. On January 1, 1909, he was appointed master mechanic at Stony Island shops and served in that capacity until February 16, 1923, at which time he was appointed superintendent of motive power with jurisdiction over the Nickel Plate and Lake Erie and Western districts.

W. G. Black

Master Mechanics and Road Foremen

E. L. BACHMAN, master mechanic of the Pennsylvania, at Mingo Junction, Ohio, has been transferred to Wellsville, Ohio.

A. W. BYRON, master mechanic of the Pennsylvania, at Wellsville, Ohio, has been appointed master mechanic, with headquarters at Renovo, Pa.

R. W. WRAY, master mechanic of the Pennsylvania, at Renovo, Pa., has been appointed master mechanic, with headquarters at West Philadelphia, Pa.

J. S. RICHARDS, assistant master mechanic of the Pennsylvania, at Akron, Ohio, has been appointed master mechanic, with headquarters at Mingo Junction, Ohio.

H. MCLENDON, roundhouse foreman of the Seaboard Air Line, at Monroe, N. C., has been appointed master mechanic at Savannah, Ga., succeeding E. H. Roy.

B. M. SWOPE, master mechanic of the Buffalo division of the Pennsylvania, at Olean, N. Y., has been appointed master mechanic at Columbus, Ohio, succeeding R. H. Flinn.

W. R. DAVIS, master mechanic of the Indianapolis division of the Pennsylvania, at Indianapolis, Ind., has been transferred to the Eastern region, with headquarters at Meadows, N. J.

D. K. CHASE, assistant master mechanic of the Middle division of the Pennsylvania, has been appointed master mechanic of the Buffalo division, with headquarters at Olean, N. Y., succeeding B. M. Swope.

O. P. REESE, superintendent of motive power of the Eastern Ohio division of the Pennsylvania, at Pittsburgh, has been appointed general superintendent of motive power of the Central region, with the same headquarters, succeeding F. W. Hankins, who has been appointed chief of motive power.

Car Department

WILLIAM H. SIMMONS has been appointed general foreman of the Pittsburgh & Lake Erie and Lake Erie & Eastern, with headquarters at Dickerson Run, Pa.

C. N. KITTLE, general foreman of the Cleveland, Cincinnati, Chicago & St. Louis, at Brightwood, Ind., has been transferred to Linndale, Cleveland, Ohio, succeeding W. A. Thomas.

T. O. QUINN, general foreman of the Cleveland, Cincinnati, Chicago & St. Louis, at Linndale, Cleveland, Ohio, has been transferred to Beech Grove, Ind., freight shop, succeeding L. C. Geisel.

WILLIAM C. LANG, assistant master car builder of the Pittsburgh & Lake Erie and the Lake Erie & Eastern, at McKees Rocks, Pa., has been appointed master car builder, succeeding Samuel Lynn.

M. E. WILCOX, foreman of inspectors of the Indiana Harbor Belt, at Gibson, Ind., has been appointed assistant superintendent car maintenance of the Boston & Maine, with headquarters at Boston, Mass.

F. B. DEMAREST, chief clerk to district master car builder of the Cleveland, Cincinnati, Chicago & St. Louis, at Springfield, Ohio, has been promoted to supervisor of inspectors, succeeding C. A. Dolby.

I. H. STALEY, car foreman of the Cleveland, Cincinnati, Chicago & St. Louis, at Springfield, Ohio, has been promoted to foreman, Shelby street coach yards, Indianapolis, Ind., succeeding W. A. Thomas.

Shop and Enginehouse

D. J. COOPER has been transferred from Concordia, Kan., to Downs, Kan., as day foreman.

J. R. MCBRIDE has been transferred from Downs, Kan., to Concordia, Kan., as day foreman.

J. D. YOUNG has been transferred from Concordia, Kan., to Downs, Kan., as night foreman.

J. M. KILFOYLE has been promoted to back-shop foreman of the Missouri Pacific at Atchison, Kan., succeeding L. A. Young.

L. A. YOUNG, back-shop foreman of the Missouri Pacific at Atchison, Kan., has been promoted to general foreman, succeeding R. Morris.

Purchases and Stores

R. J. GABLE, storekeeper of the Indiana division of the Illinois Central, at Mattoon, Ill., has been transferred to Clinton, Ill., to succeed J. W. Cockrill.

G. F. OHDEN, storekeeper of the Mississippi division of the Illinois Central, at Water Valley, Miss., has been transferred to Mattoon, Ill., succeeding R. J. Gable.

J. W. COCKRILL, storekeeper of the Springfield division of the Illinois Central at Clinton, Ill., has been appointed division storekeeper with headquarters at Centralia, Ill., succeeding A. E. Walters.

G. D. TOMBS, assistant storekeeper of the Vicksburg Route division of the Yazoo & Mississippi Valley, at Vicksburg, Miss., has been promoted to division storekeeper with headquarters at Water Valley, Miss., succeeding G. F. Ohden.

A. E. WALTERS, division storekeeper on the Illinois Central, at Centralia, Ill., has been transferred to the Memphis division of the Yazoo & Mississippi Valley, with headquarters at Memphis, Tenn., succeeding G. W. Rice, resigned.

RALPH L. TINDAL, chief clerk to the vice-president and general manager of the New York, Chicago & St. Louis, has been promoted to purchasing agent of the Nickel Plate and Lake Erie & Western districts, with headquarters at Cleveland, Ohio, succeeding W. P. Dittoe. Mr. Tindal was born on July 15, 1889, at Ogdensburg, N. Y. After attending the Ogdensburg public schools and the Ogdensburg Free Academy he entered railway service on February 1, 1912, in the mechanical department of the Nickel Plate at Cleveland, Ohio. He served for a time as chief clerk to the master car builder, and on January 1, 1919, he was appointed chief clerk to the superintendent of motive power. He remained here until September 1, 1923, when he became chief clerk to the vice-president and general manager.

WALTER E. EVANS, who has been appointed purchasing agent of the Grand Trunk Western System of the Canadian National, with headquarters at Detroit, Mich., was born in Montreal, Que., on April 17, 1888, and entered railway service as a clerk in the purchasing department of the Grand Trunk (now a part of the Canadian National) in Montreal in 1906. Ten years later he became accountant, and in April, 1920, became chief clerk and accountant of the office. In April, 1923, Mr. Evans was appointed assistant fuel agent at Toronto, Ont., and in September of the same year became chief clerk to the vice-president in charge of purchases and stores. On May 1, 1924, he returned to Montreal as assistant to the general purchasing agent, which position he was holding at the time of his recent appointment.

W. E. Evans

Obituary

HENRY OTTO, past president of the American Railway Tool Foremen's Association and for many years general tool foreman of the Atchison, Topeka & Santa Fe at Topeka, Kans., died on January 9, 1927, at Kansas City, Mo. Mr. Otto was born at Cologne, Germany, August 16, 1864. He was educated in the public schools, which he attended until 1878, when he entered a technical school. He received his mechanical training with one of the large machine manufacturers at Cologne, after which he was sent out by this company as an erecting engineer, traveling through Germany and South America setting up machinery. On January 11, 1902, he came to America and began his railway service with the Union Pacific as a machinist at Omaha, Neb. He assisted materially in developing the McKeen gasoline passenger motor car which was used later on the Union Pacific and other railroads. In 1907 he left the services of the Union Pacific to become tool foreman on the Lehigh Valley at Sayre, Pa., remaining in this position until January 25, 1910. He then entered the service of the Atchison, Topeka & Santa Fe as general tool foreman at Topeka, Kans., which position he held until the time of his death.

HENRY A. COOPER, former purchasing agent of the Zanesville & Western and the Toledo & Ohio Central (both now parts of the Ohio Central lines of the New York Central), died on February 8 at his home at Toledo, Ohio. Mr. Cooper was born on August 29, 1846, at Utica, N. Y., and after serving the Union army during the civil war as a civilian train dispatcher, he entered the service of the Erie as a telegraph operator on the line between Hornell, N. Y., and Dunkirk. In 1866 he became a train dispatcher on the Third and then the Fourth divisions of the Atlantic & Great Western (now a part of the Erie) where he remained until 1873 when he was appointed a trainmaster on the New York, Pennsylvania & Ohio (a part of the Erie). Mr. Cooper was appointed superintendent of telegraph of the Toledo, Delphos & Burlington, a narrow gage railroad (now a part of the New York, Chicago & St. Louis) in 1882, becoming chief clerk and private secretary to the general manager of the New York, Pennsylvania & Ohio at Cleveland, Ohio. He was promoted to superintendent of transportation in 1886 and three years later he was appointed division superintendent of the T. & O. C. In 1892 he left the operating department to enter the purchasing department as purchasing agent, remaining with this railroad and the Z. & W., with headquarters at Toledo, until 1915 when he was appointed stationer. In 1922, when the two companies became the Ohio Central lines of the New York Central he was appointed stationer, a position he held until his retirement in 1925.